Water Plant Optimization Study

DRESDEN WATER TREATMENT PLANT

May 1991

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WATER PLANT OPTIMIZATION STUDY

Dresden

Water Treatment Plant

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DRESDEN WATER TREATMENT PLANT
WATER PLANT OPTIMIZATION STUDY
FINAL REPORT

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EXECUTIVE SUMMARY

Background of Study

The Ontario Ministry of the Environment (MOE) has instituted a Water Plant Optimization Study (WPOS) to determine the optimum treatment strategy for contaminant removal at Ontario Water Treatment Plants (WTP). The WPOS at Dresden was conducted as a part of an ongoing process to provide a continuously updated base of information on the WTP and water quality. As a part of this study, an investigation, process evaluation and study of three years of daily operating data were conducted at the Dresden WTP.

Description of Dresden Water Treatment Plant

The Dresden WTP is located on the south bank of the Sydenham River in Dresden. The WTP is a conventional sedimentation-filtration plant with a capacity of 3 ML/d.

The WTP services a population of approximately 2,570 people, nearby farms and the following industries:

- Nabisco Brands Ltd.
- National Hardware/W. G. Die Casting
- and Kardinal Coatings.

The WTP was completed in 1957 as a lime-softening plant. In 1976, the plant was converted to a sedimentation filtration plant. The following chemical processes were added to the plant:

- alum and activated silica for coagulation
- lime to aid settling
- Powdered Activated Carbon (PAC) for removal of organics

- potassium permanganate for removal of taste, odour and colour
- chlorine for disinfection.

An elevated storage tank was completed in 1986.

The plant has been known to have problems meeting water demand and producing an aesthetically pleasing product. During the three years of data reviewed, 1987 to 1989 inclusive, water demand was as high as 4.746 ML/d. Many exceedances in the MOE guidelines for turbidity (1.0 FTU), and colour (5 Hazen Units), were reported. Occasionally, positive results were encountered in bacteriological testing in the water distribution system. In general, treated water quality is highly variable.

In part, variability in treated water quality can be attributed to the increasing demand, which has exceeded plant capacity. Highly variable raw water quality and seasonally high industrial use are also problems. However, it is antiquated equipment and a lack of process control which make it difficult for operators to produce a consistent water quality. Some process improvements are required to provide a consistently good treated water quality.

Operation of the WTP tends to be labour intensive; for example, filter backwashing is manually started and stopped. Some operations, such as the process of preparing powdered activated carbon slurry, are a health and safety concern.

Spirit of Report

Due to concern of the suitability of the Sydenham River as a source of drinking water, the Town has been intent on gaining access to Lake Huron as a water supply. Since a pipeline to Dresden from Lake Huron is being planned, with water treatment

at another WTP, the goal of this report is to emphasize short-term process modifications to the WTP to obtain optimum contaminant removal.

Recommendations
- Process Modifications

1. Upgrade all electrical equipment and wiring to "explosion-proof" in the PAC room.

2. Provide dust collection system and proper venti-lation of the PAC room.

3. Remove existing dry alum feeder. Install a liquid alum system at the low lift pump station with alum addition to the low lift pump discharge line.

4. Move the location of the activate silica addition point to the current alum addition point.

5. Discontinue use of lime.

6. Conduct tests to determine optimum speed setting on flocculator drive of the solids-contact clarifier.

7. Replace worn out settling tubes in solids-contact clarifier.

8. Existing filter surface wash water taken from the backwash header does not provide sufficient pressure for surface cleaning. Take surface washwater from the WTP service water line.

9. Provide a back-up pump for the clarifier effluent pump.

10. Provide emergency filter backwash piping from water storage tank.

11. Install an air release valve in backwash pump discharge pipe to exhaust air in pump column.

12. Install gauges to monitor headloss in the filters.

13. After backwashing, the initial filtered water should be wasted.

14. Consider using secondary as granular activated carbon contactor. Thus, PAC use could be discontinued.

15. Install raw, treated and backwash water flowmeters.

16. Install chlorine residual analyzer with recorder and, high and low chlorine residual alarm.

17. Install remote chlorine detector outside Chlorine Room.

- **Non-Process Modifications**

1. A better ventilation system is required in the low lift pump station.

2. The drain in the low lift pump station should be rodded. Verification is required as to whether this drain empties into the low lift pump well. The drain should be connected to the sanitary sewer.

3. All mercury filled floats and switches should be removed and replaced with equipment more suitable for a WTP.

4. To facilitate plant operation, an operating manual should be prepared.

DRESDEN WATER TREATMENT PLANT
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INTRODUCTION AND TERMS OF REFERENCE

The Ontario Ministry of Environment (MOE) has instituted a Water Plant Optimization Study (WPOS) consisting of a continuously updated base of information on Ontario Water Treatment Plants (WTP) and water quality. The purpose of the study is to document and review the current conditions and to determine the optimum strategy for contaminant removal at water treatment plants. As a part of this study, an investigation, process evaluation and study of three years of operating data were conducted for the Dresden WTP. A copy of the Terms of Reference for this study can be found in Appendix I.

BACKGROUND

The Dresden WTP is located on the south bank of the Sydenham River, on Peel Street in Dresden (see Figure 1). The WTP is owned by the Town and operated by staff from the MOE. The 3 ML/d[1] (0.66 MGD[2]) supplies water to a population of approximately 2,570 people. In addition, water is supplied to:

- Nabisco Brands Ltd. (previously Canadian Canners)
- National Hardware/W.G. Die Casting
- Kardinal Coatings
- and nearby farmers.

The WTP is a conventional sedimentation-filtration plant. Alum is used as the prime coagulant with activated silica used

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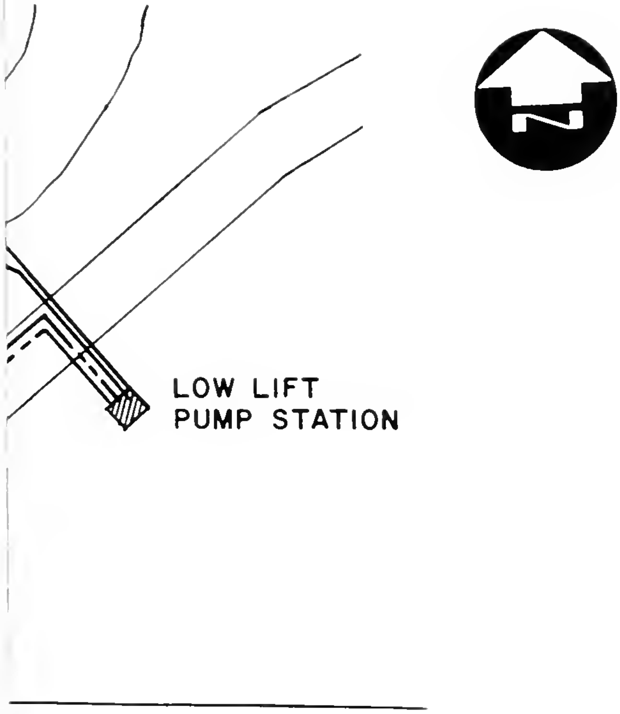
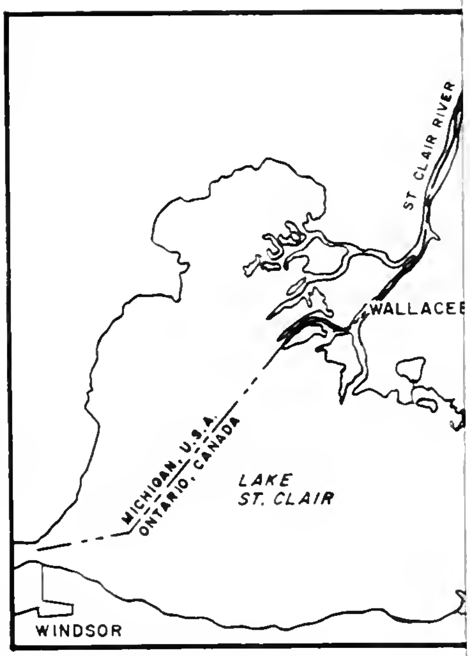
[1]ML/d = million litres/day

[2]MGD - million Imperial gallons per day





LOCATION PLAN

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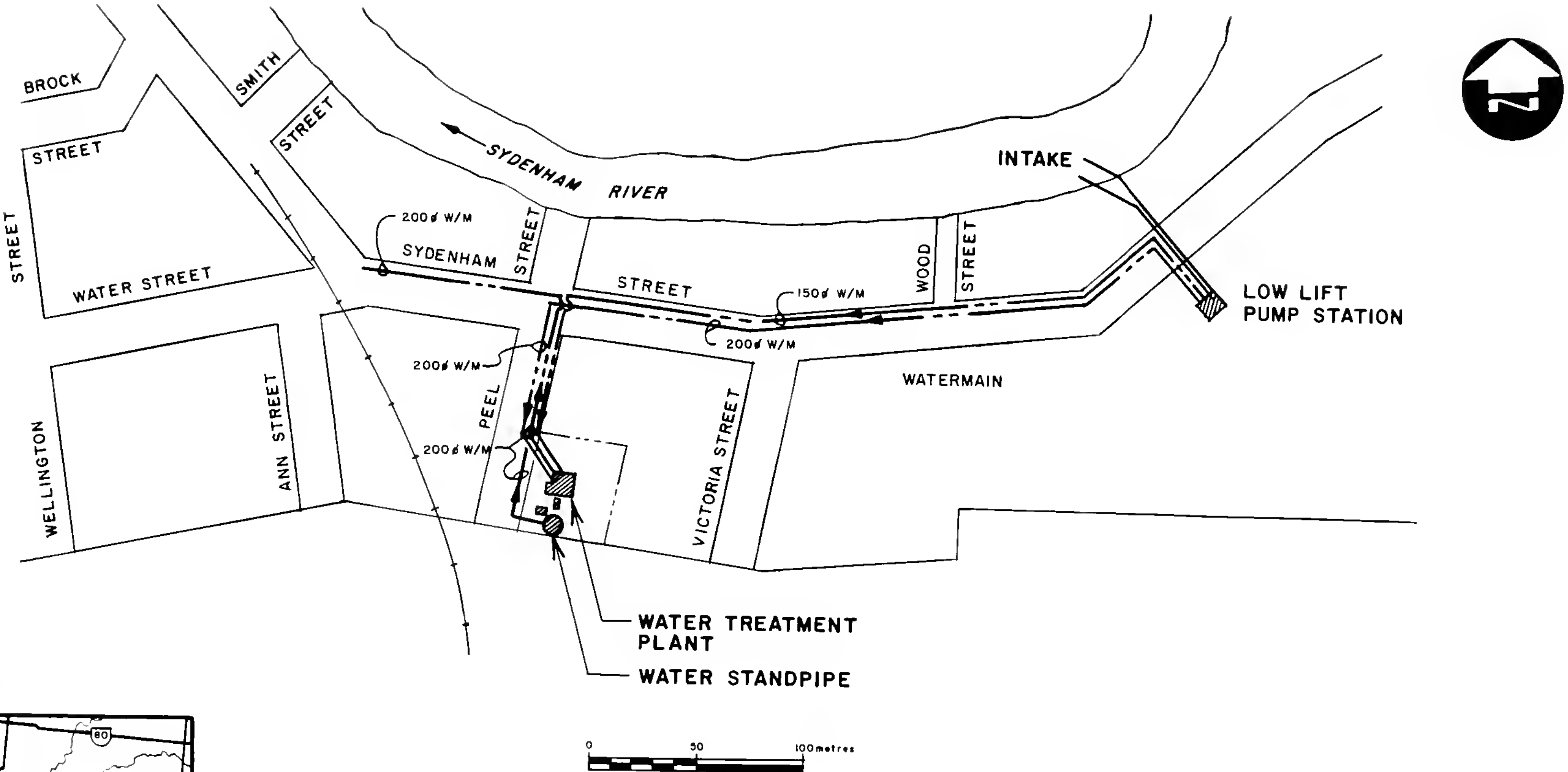
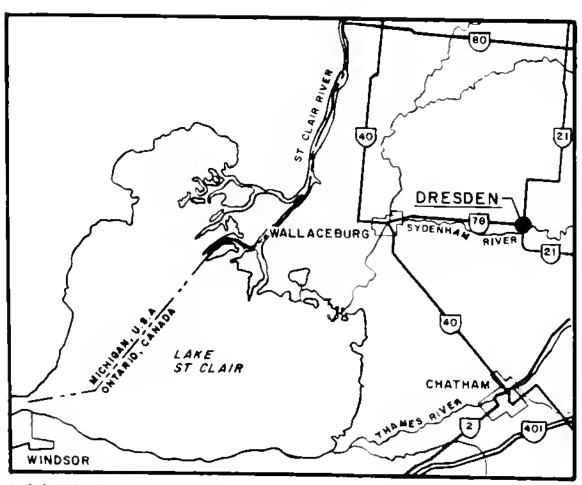
DRESDEN WPOS

SITE PLAN

FIGURE 1





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DRESDEN WPDS

SITE PLAN

FIGURE
1

as a coagulant aid. In the winter, lime is added to aid settling. Potassium permanganate and powdered activated carbon (PAC) are used for taste, odour and colour control. PAC has also been used at higher concentrations for removing herbicides and pesticides. Treated water is chlorinated for disinfection. Treated water is stored in and distributed from a 3.38 ML (0.746 MG) elevated water storage tank.

History of the WTP

The original WTP, completed in 1957, was designed as a lime-soda softening plant to treat a well water supply. In 1967, settler tubes were added to the clarifiers to increase capacity and provide better sedimentation. In 1976, the well water supply was discontinued and the plant was converted to a surface water supply from the Sydenham River. Gravity filters were added to the treatment process, in addition to chemical treatment for taste, odour and colour control and coagulation. The elevated water storage tank was completed in 1986.

In recent years, the plant has been known to have problems meeting water demand and producing an aesthetically pleasing drinking water. In part, this can be attributed to an increasing demand which has exceeded plant capacity. For example, the solids contact clarifier is too small to handle present, average and maximum day flows. Seasonally high industrial water use and variable raw water quality also create problems at the plant, since there is little process automation and control.

Many process components are antiquated; new parts cannot be purchased to replace worn parts. Some process components and instrumentation have worn out and have not been replaced. Temporary repairs have been allowed to become permanent

operational components. Operation of the WTP tends to be labour-intensive and time-consuming. Little time is available for cleaning and maintenance of the WTP so that some processes appear unclean and run-down. Lack of process control and the antiquated equipment have made it difficult for operators to produce a consistent treated water quality.

Since the late 1970's, the Town has been intent on gaining access to Lake Huron as a water supply, due to concern by the Town of the suitability of the Sydenham River as the source of drinking water. Initially, the project was deemed uneconomical since neighbouring towns and townships decided not to take part in the proposed supply via the East Lambton Area Water Supply System. Concern over toxic chemical spills into the St. Clair River prompted a study of water supply for the affected municipalities in Lambton and Kent Counties. The study recommended a new watermain from the West Lambton water supply system to Dresden, which would also supply:

- Town of Wallaceburg,
- Walpole Island,
- Township of Chatham,
- Sombra Township and
- Camden Township.

Recent increases in the number of reported chemical spills into the St. Clair River from various industries in Sarnia have escalated public concern in downstream communities who use the St. Clair River as their water supply, especially, Wallaceburg and Walpole Island. Town Councils and citizen's groups have called for provincial and federal support to hasten the design and construction of a Lake Huron water supply. Provincial government support for the Lake Huron supply is in place at 75 percent of project cost. The federal government has not yet promised any financial support for this project.

Spirit of Report

In light of the fact that a pipeline supply from Lake Huron to Dresden, with water treatment at the Lambton or other WTP, is being planned, the goal of this study is to emphasize short-term process modifications to the plant, to obtain optimum contaminant removal and disinfection. The focus of recommendations is modifications which can, for the most part, be completed quickly and economically by WTP staff.

Study Period

Plant operating data (MOE Utility Monitoring reports) were received from the operating staff at the WTP for 1987, 1988 and 1989. Operating data for 1989 were incomplete due to the breakdown of the treated water flow recorder.

Copies of typical utility monitoring sheets are appended (Appendix II).

Annual reports for the Drinking Water Surveillance Program (DWSP) were received for 1986 and 1987.

Plant data reported in this study are based on the above information.

A: RAW WATER SOURCE

A:1 SOURCE

The Dresden WTP takes raw water from the Sydenham River, approximately 8m from the river bank 300m east of the WTP. Raw water is drawn in through a coarse screen in a 450 mm pipe.

A permit to take water from the Sydenham was issued in early 1989.

Upstream use of the Sydenham River watershed for agriculture is a major concern. Pesticides, presumably from agricultural run-off, have been detected in the raw and treated water during routine monitoring.

In addition, there are a number of water users and discharges along the Sydenham. In Alvinston, located about 30 km upstream of Dresden, the MOE operates a 0.6 ML/d secondary sewage treatment plant which discharges into the Sydenham. Average day flows and effluent quality parameters for the plant are (1988)[1]:

-	Average Day:	0.177 ML/d
-	BOD_5	2.7 mg/L
-	Suspended Solids (SS)	5.8 mg/L
-	Ammonia (as N)	0.58 mg/L
-	Total Phosphorus	0.33 mg/L

Effluent quality is within guidelines set by the MOE for discharges for the Alvinston STP.

Strathroy, located 60 km upstream of Dresden, operates a lagoon system which periodically discharges to the Sydenham.

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[1]Source: Telephone Communication, Mr. B. Boland, MOE, 18 April 1989.

The average monthly discharge parameters from the lagoon system for the first two months of 1989 are[1]:

		January	February
Flow	m^3/mo	78,558	64,147
	ML/d	2.534	2.291
BOD_5	mg/L	11.9	11.4
SS	mg/L	23.3	14.3
Ammonia (as N)	mg/L	4.2	2.03
TKN	mg/L	8.23	5.5
Total P	mg/L	0.41	0.53

The Strathroy STP meets MOE requirements for discharge, namely:

- BOD_5 = 30 mg/L
- SS = 40 mg/L
- Total P = 1.0 mg/L

Consultants have been engaged to study expansion of the Strathroy STP, which is approaching hydraulic capacity. Design of the existing 3-cell aerated lagoon followed by 2-cell facultative lagoons in series, made provisions for addition of 2 aerated cells if an expansion were required.

A fertilizer plant located in Watford discharges spill water from its storage pond to Brown's Creek which drains into the Sydenham north of Alvinston. No monitoring is conducted of effluent from the plant's storage pond.

A:2 QUALITY

A:2:a Physical and Chemical

During the study period, the general physical and chemical raw water quality parameters varied as follows:

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[1]Source: Telephone Communication, Mr. D. Matheson, MOE 18 April 1989.

TABLE I

PHYSICAL AND CHEMICAL RAW WATER QUALITY

Parameter (Units)	Range	Average
Turbidity (FTU)	6-732	55
Colour (Hazen Units)	0.5-210	31
Temperature (°C)	0.5-35	12
Hardness (mg/L as $CaCO_3$)	190-632	298
Alkalinity (mg/L as $CaCO_3$)	130-466	200
pH	6.7-8.7	7.9
Nitrate	0-16.8	4.9

Source: MOE Utility Monitoring Records

Water from the Sydenham tends to be coloured and turbid. Incidents of high colour and turbidity correspond with the rainy season. Colour in the raw water is likely caused by natural organic substances.

Raw water temperatures at Dresden were higher than desirable during the summer months (June to September, inclusive). Drinking water temperatures below 15°C are desirable since palatability is enhanced by the coolness of the water. Raw water temperatures above 15°C are often encountered in the summer in WTP's in southwestern Ontario; water temperatures at the Lambton WTP also exceed the 15°C guideline, in the summer.

Raw water hardness is high; typically, hardness greater than about 200 mg/L as $CaCO_3$ is considered to be poor since it causes scale formation and also results in excessive soap use. Hardness is not significantly reduced in a conventional water treatment plant. However, consumers do become accustomed to higher hardness levels.

High nitrate levels in drinking water are a problem because of their relationship to infantile methaemoglobinaemia. Nitrate is highly soluble and is not removed by conventional treatment. The Ontario Drinking Water Objectives recommended a

maximum acceptable concentration (MAC) of nitrate in drinking water of 10 mg/L as N.

At Dresden, the nitrate level averaged 4.9 mg/L during the study period, with occasional exceedances of 10 mg/L. Considering that the Sydenham River watershed is agricultural, occasional exceedances of nitrate levels are not unexpected. Because of the health implications, the local health authority, the Chatham Health Unit, regularly receives data on nitrate concentrations so that the public can be notified if levels exceed the MAC.

A:2:b Bacteriological

During the study period, Total and Fecal Coliforms and Fecal Streptococcus were present in every raw water sample. Counts ranged from:

- Total Coliform: 1 to >5000 per 100 ML
- Fecal Coliform: 1 to >500 per 100 ML
- Fecal Streptococcus: 1 to >50 per 100 ML.

No Total or Fecal Coliforms nor Fecal Streptococcus were found in the treated water samples.

A:2:c Pesticides

In conjunction with the Drinking Water Surveillance Program (DWSP), pesticides are monitored.

In 1986, 23 pesticides were analyzed for their presence in raw water. None were found above trace levels in monthly sampling. Other pesticides were added to the list to correspond with use of the pesticide on agricultural land in the Sydenham watershed. Only atrazine was found above trace levels, as listed in Table II, but was well below the guideline concentration of 60 000 ng/L set by Health and Welfare Canada.

In 1987, of the 36 pesticides and PCB and 23 specific pesticides analyzed in June and November, only six were detected. These are listed in Table II.

It can be seen that most occurrences were in the spring and summer months. This may be due to higher use of pesticides in the late spring/early summer, combined with low flow in the Sydenham River at this time.

On a weekly basis, samples are submitted to the Ministry of Agriculture and Food for pesticide testing.

TABLE II

RESULTS OF DWSP TESTING FOR SPECIFIC PESTICIDES IN RAW WATER FROM SYDENHAM RIVER (ng/L)

Pesticides	Concentration ng/L					Limit of Deflection ng/L	Health & Welfare Canada Guideline ng/L
	1987		1986				
	June	November	April	May	December		
Alpha BHC	1.000 <T	!IS	-	-	-	1.000	700
Lindane	3.000 <T	!IS	-	-	-	1.000	4 000
Atrazine	14400	BDL	740	1410	610	50	60 000
Bladex	3200	BDL	-	-	-	100	10 000
2,4-DP	BDL	410 <T	-	-	-	100	N/A
Metolachlor	9020	BDL	-	-	-	500	50 000
Dicamba	BDL	BDL	-	-	-	100	87 000

BDL = Below detection limit
<T = Greater than detection limit, but not confident
!IS = No Data: Insufficient Sample

Source: Drinking Water Surveillance Program, Annual Reports, 1986 and 1987

B: FLOW MEASUREMENT

Backwash and treated water flow recorders are installed at the water treatment plant. Plant staff report that the backwash flow recorder has never worked. The treated water flow recorded has not functioned since March 1989. Currently, there is no method of metering treated water. Plant staff report that treated and raw water flow meters are on order.

Backwash water usage can be calculated based on the capacity of the backwash pump and backwash duration. On average, 0.075 ML (16,500 Igal) of treated water is used per filter per backwash. Normally, each filter is backwashed once daily, for a total backwash water usage of 0.15 ML/day. This is about 5% of the capacity of the WTP, which is typical for normal WTPs. During periods of high turbidity, for example, during spring runoff, each filter may be backwashed three or four times daily. Therefore, as much as 0.6 ML/day, 20% of WTP capacity is used for backwashing during these periods.

Service water includes make-up water for chemicals and sampling. Treated water is sampled from the taps in the laboratory. Water is kept running to ensure that samples represent treated water and not water which has been standing in the sample piping. This uses over 5,000 L/d. Make-up water for chemicals uses over 6,000 L/d. A water meter has been installed at the activated silica make-up tank to measure treated water used for activated silica make-up.

C: PROCESS COMPONENTS

C:1:a General

The Dresden WTP is a conventional plant with:

- raw water screening,
- alum and activated silica coagulation,
- potassium permanganate for taste, odour and colour control,
- powdered activated carbon for taste and odour control and adsorption of organic chemicals,
- flocculation/sedimentation,
- filtration,
- disinfection.

The treatment processes are shown as a block flow schematic in Figure No. 2.

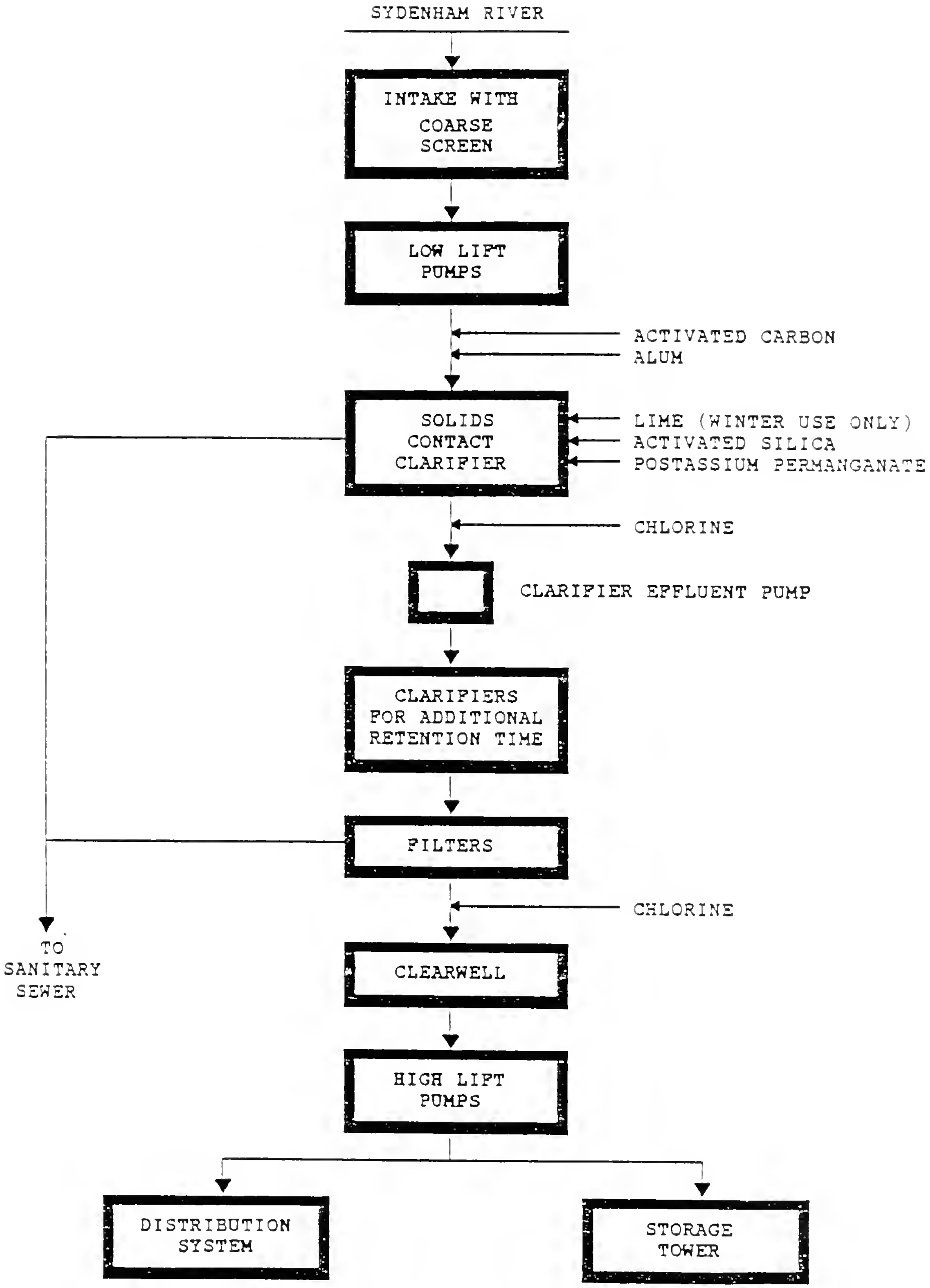
C:1:b Plant Layout

The low lift pump station is located near the river bank. It houses:

- the raw water well,
- screens,
- low lift pumps,
- raw water pumps supplying Nabisco,
- PAC storage, mixing and dosing,

as shown in Figure 3.

A room behind the pump station is used for storing and mixing the PAC.



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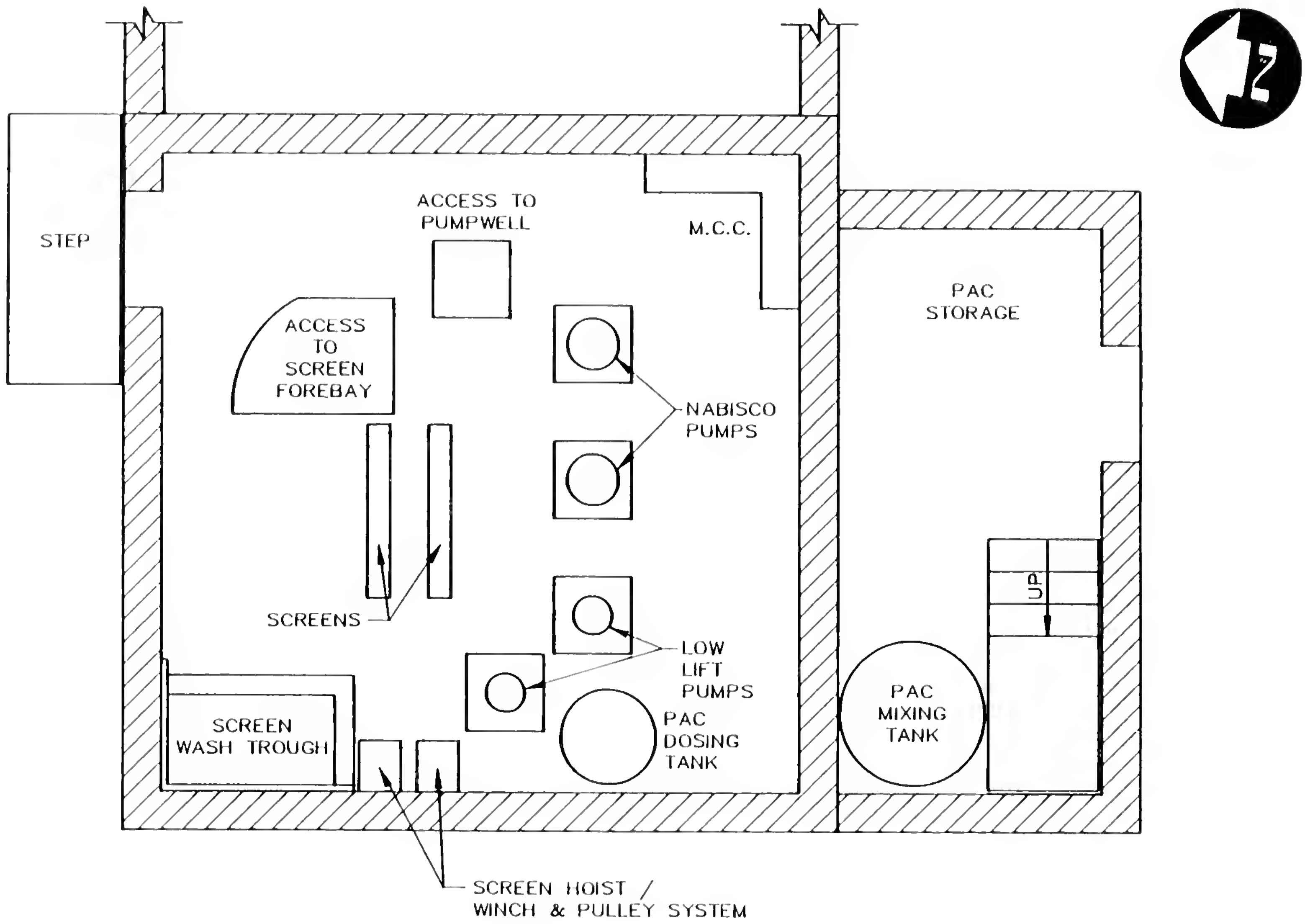
W.T.P.
BLOCK FLOW

FIGURE
2



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LOW LIFT PUMP STATION

FIGURE 3

The main WTP building is located west of the low lift pump station. Layout of the three levels in the WTP building is shown on Figures No. 4, 5 and 6.

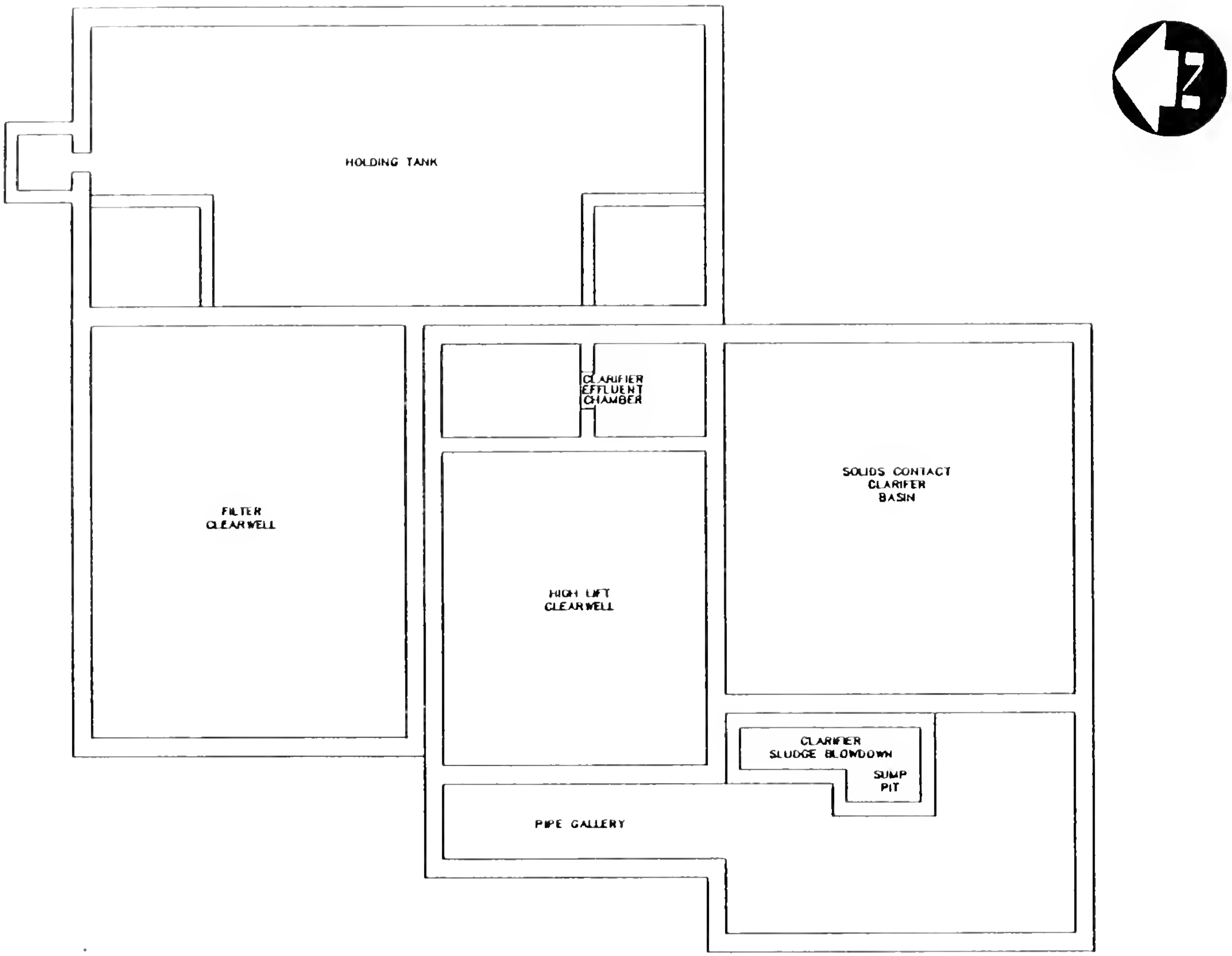
The process components are divided as follows:

Main level:	chemical addition area
	solids contact clarifier
	high lift pump area
	work area
	electrical area with motor control centre and annunciator board
	chlorine room
	filter pipe gallery.
Lower level:	high lift clearwell
	holding tank
	filter clearwell
	clarifier effluent pump chamber
	influent pipe gallery
	sump and pump for clarifier sludge blowdown and discharge to sanitary sewer.
Upper level:	filters
	chemical storage room
	chemical mixing area
	laboratory and office.

Access to the upper level is via stairs. Access to the lower level is by a ladder.

The elevated water storage tank and the storage tank monitoring building are located adjacent to the WTP.

Photographs of the low lift pump station, WTP and water storage tank are in Appendix III.



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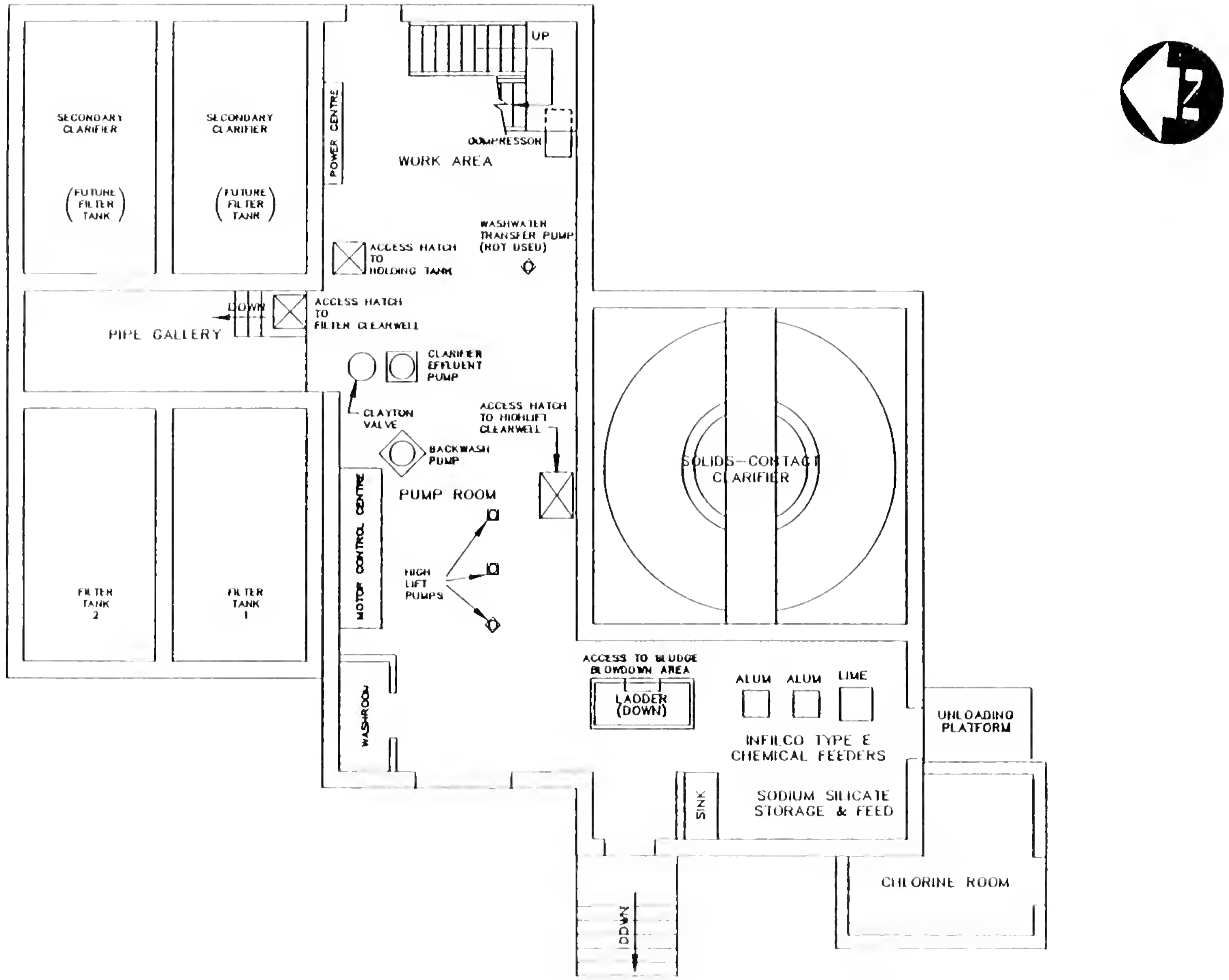
WTP
LOWER LEVEL

FIGURE 4



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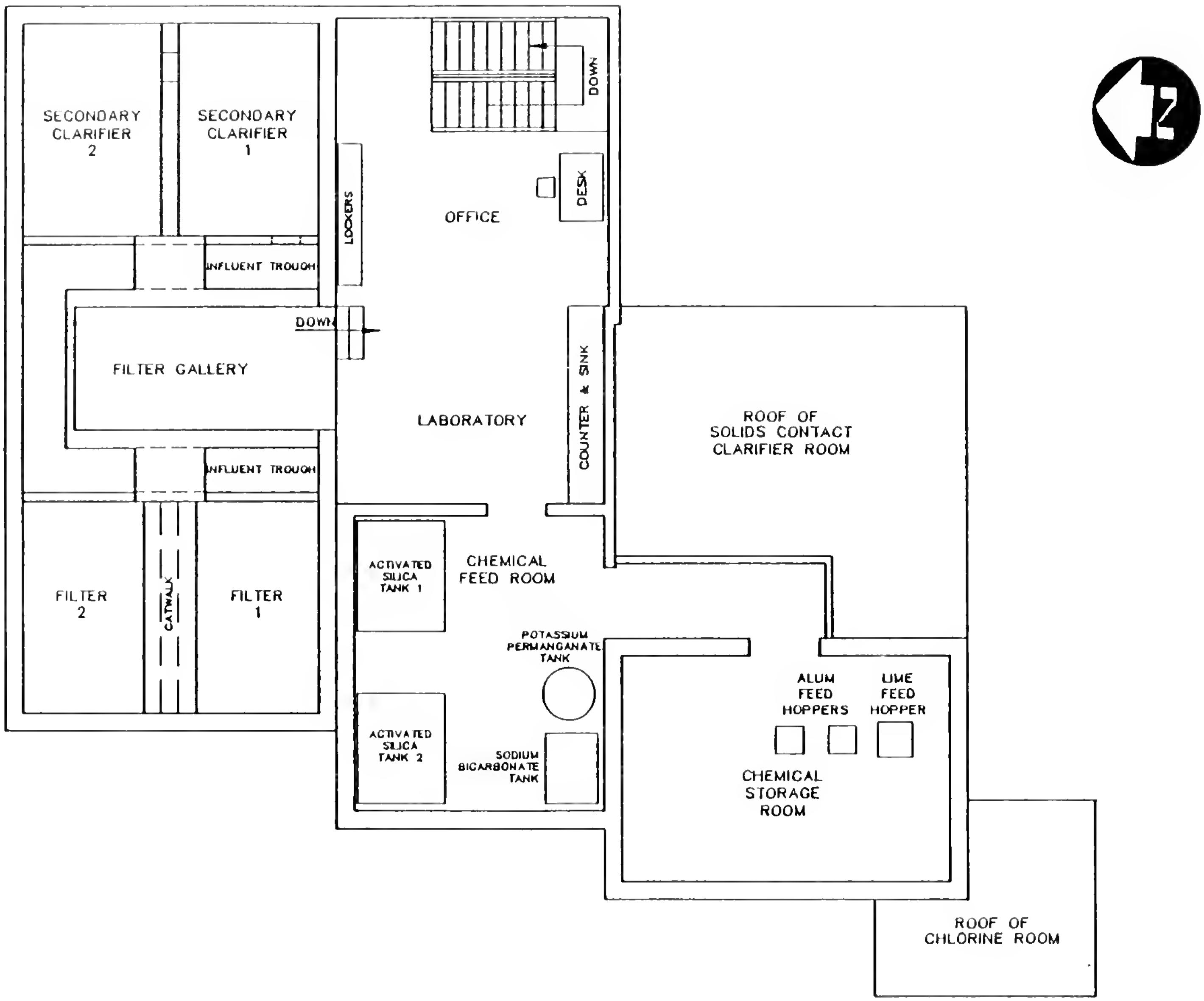
WTP
MAIN LEVEL

FIGURE
5



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WTP
UPPER LEVEL

FIGURE 6

C:2 DESIGN DATA

C:2:a Capacity

The nominal rated capacity of the WTP is 3 ML/d (0.66 MGD). Water demand ranged from 0.867 ML/d to 4.746 ML/d during the study period (from available data). Table 1.0 in Appendix IV shows minimum, maximum and average monthly flows from 1987 to 1989.

Table 1.1 in Appendix IV shows per capita flows in 1987, 1988 and 1989. Average day per capita flow is 1469 L/c/d in 1989. This is high and is a reflection of high industrial water use.

The largest industrial user of water is Nabisco Brands. Although Nabisco has its own water treatment plant, it supplements its supply with Town water. Metered water data received from the Dresden Public Utilities Commission show that Nabisco's water usage peaks in October (data from 1986-1988, inclusive). In 1988, October water usage was 55.5 ML, an average of 1.79 ML/d. This is 54 per cent of the average day treated water flow in October.

C:2:b Factors Affecting Capacity

The plant capacity, 3 ML/d, is consistent with a filter rate of 5.8 m/hr (2 gpm/ft^2). The low filter rate is required to meet the MOE filtered water turbidity guideline of 1.0 FTU and to obtain reasonable filter run times under the high water turbidity conditions under which this plant operates.

The clarifier tends to deliver a turbid effluent at flows in excess of about 2.3 ML/d (0.5 MGD) or a surface loading rate of 2.9 m/hr (1 gpm/ft^2). Converting the two empty filter tanks to secondary clarifiers has, to some extent, improved the quality of the water entering the filters.

The plant is too small to adequately treat average day demands and cannot meet maximum day demands.

Excessive backwashing required during periods of high turbidity affects water production. During these periods, as much as 20% of the treated water is used for backwashing. Backwashing water use should not exceed 5% of plant capacity.

The 3.38 ML water storage tank provides approximately one day storage.

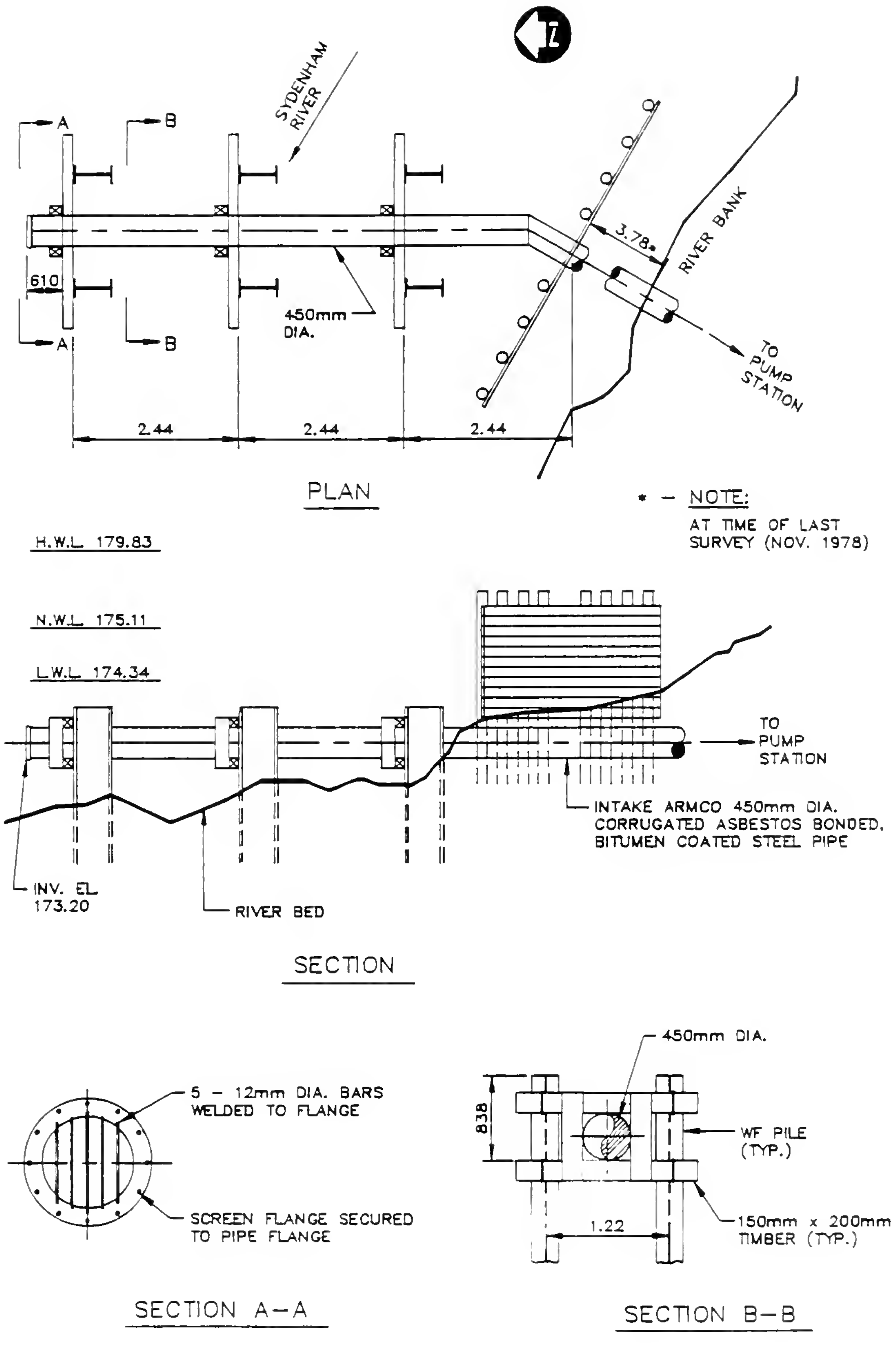
C:3 PROCESS COMPONENT INVENTORY

C:3:a Intake

- Pipe: 58 m of 450 mm diameter asbestos bonded bitumen coated corrugated steel pipe
- Location: ≈ 8m off shore
- Depth: 1.9m average
- Type: pipe with coarse screen
- Velocity: 0.22 m/s at design capacity

The intake pipe is supported above the bottom of the river bed by pressure treated wood connected to 5.5m long steel piles. A coarse screen is secured to the end of the intake. The screen is formed with 12 mm diameter bars spaced at 75 mm on centre. Details of the intake are shown on Figure 7. The invert elevation of the intake is 173.20m.

An alternate emergency intake is available. This intake was designed for use when the water level falls below the invert level of the normal intake. A submersible Flygt pump draws raw water from the river into 150 mm diameter pipe to the low lift pump well. The pump capacity is, approximately 65 L/S at 12m TDH.



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DRESDEN WPOS

INTAKE STRUCTURE

FIGURE 7

C:3:b Screening

- Number: Two
- Dimensions: 0.91m x 1.37m
- Type: Stationary stainless steel
- Opening Size: 3.2 mm openings (1/8")

The original screens were a commercial bronze mesh with 9.6 mm openings and supported by a Douglas Fir frame. One of these screens was recently replaced by plant staff. The new screen is a stainless mesh supported by a wooden frame in a similar manner as the original screen.

The top of each screen is secured with a galvanized wire rope which is wound around a pulley system which leads to a wall-mounted, motorized winch. This system allows the screens to be lifted for inspection and cleaning. In the wet well, each screen is held stationary in a 10m vertical frame made of two steel wide flange I-beams.

C:3:c Low Lift Pumping

Pump No.	Capacity L/s	Head m	Type	Motor kW	Manufacturer	Service
1	38	N/a	Vert. Turbine	22.4	Johnston	Town
2	58	17.4	Vert. Turbine	22.4	Johnston	Town
3	68	78.6	Vert. Turbine	74.6	Peerless	Nabisco
4	68	79.2	Vert. Turbine	74.6	Peerless	Nabisco

(N/a - not available)

Raw water from the low lift pump station can be taken via 150 mm and 200 mm diameter pipes to the WTP. Plant staff report that the 150 mm pipe, installed in 1956, is deteriorated.

C:3:d Flash Mixing

There is no flash mixing of chemicals. PAC slurry is injected in the low lift header downstream of low lift pumps. Alum is injected in the raw water influent line at the plant. Both additions depend on the turbulence in the line to obtain mixing.

C:3:e Solids Contact Clarifier

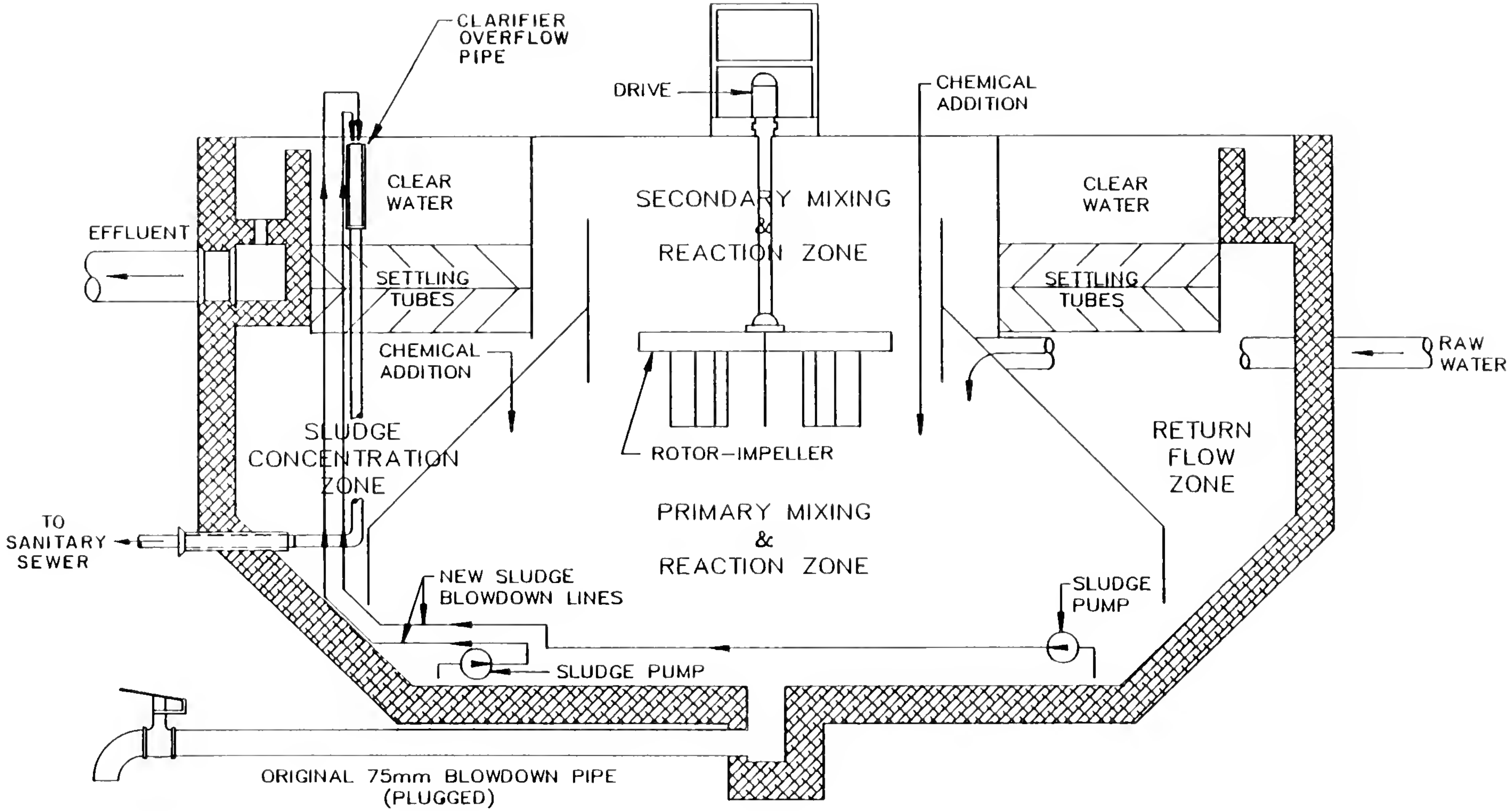
Flocculation and sedimentation take place in an Infilco solids contact clarifier (shown in Figure 8). In this package unit, the flocculation zone is in the centre of the unit and sedimentation is in the annular ring around the flocculation zone.

Flocculation

The flocculation tank consists of two zones: a primary mixing and reaction zone and a secondary mixing and reaction zone. An impeller rotor mixes the incoming raw water, chemicals and previously formed floc in the primary zone. The impeller circulates the floc to the secondary zone for continued mixing and solids contact. The floc discharges down between the inner and outer draft tubes along the hood through a sludge blanket. Water is forced upward and sludge is drawn back under the hood to the primary mixing zone by the rotor.

The rotor-impeller is operated by a variable speed drive motor with these characteristics:

Motor:	U.S. Electric 1.5 kW (2 hp), 60 Hz, 575V, 3 phase Output: 88.8 to 888 rpm



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DRESDEN WPOS

SOLIDS CONTACT CLARIFIER

FIGURE 8

A stand-by motor is available:

Motor: U.S. Varidrive
1.12 kW (1.5 hp), 60 Hz, 575V, 3 phase
Output: 200 to 600 rpm

Plant staff report that it is no longer possible to purchase or obtain parts for these motors.

The speed of the rotor can be manually adjusted by adjusting the dial setting on the motor (1 to 10). No calibration curve is available to relate the setting to the speed.

Sedimentation

Flocculated water flows from the secondary mixing and reaction zone, over a baffle to the sedimentation zone. The sedimentation zone is formed by a 1.5m wide (approximately) annular ring around the flocculation zone. The sedimentation zone has been retrofitted with tube settlers.

The solids contact clarifier operates best at a surface loading rate less than 2.9 m/hr (1 gpm/ft^2), or 2.3 ML/d (0.5 MGD). At 1988 average day demand of 3 ML/d, the surface loading rate was 3.8 m/hr (1.3 gpm/ft^2).

C:3:f Clarifier Effluent

Effluent from the solids contact clarifier flows to the clarifier effluent chamber:

Dimensions: 4.34m x 1.52m x 3.43m depth (top water level - TWL)

Volume : 22.64 m^3

Clarifier effluent is pumped from this chamber to secondary

clarifiers. The clarifier effluent pump has the following characteristics:

Pump No.:	P7
Type:	Vertical Turbine
Manufacturer:	Crane Deming
Capacity:	68 L/s @ 7.6m head
Power:	7.5 kW (10 hp)

Pumping is controlled by a Clayton butterfly valve. When the water in the chamber reaches a pre-set level, the valve opens and water is pumped up to the secondary clarifier.

The position of the Clayton valve (open or closed) is hydraulically actuated by a rotary control valve.

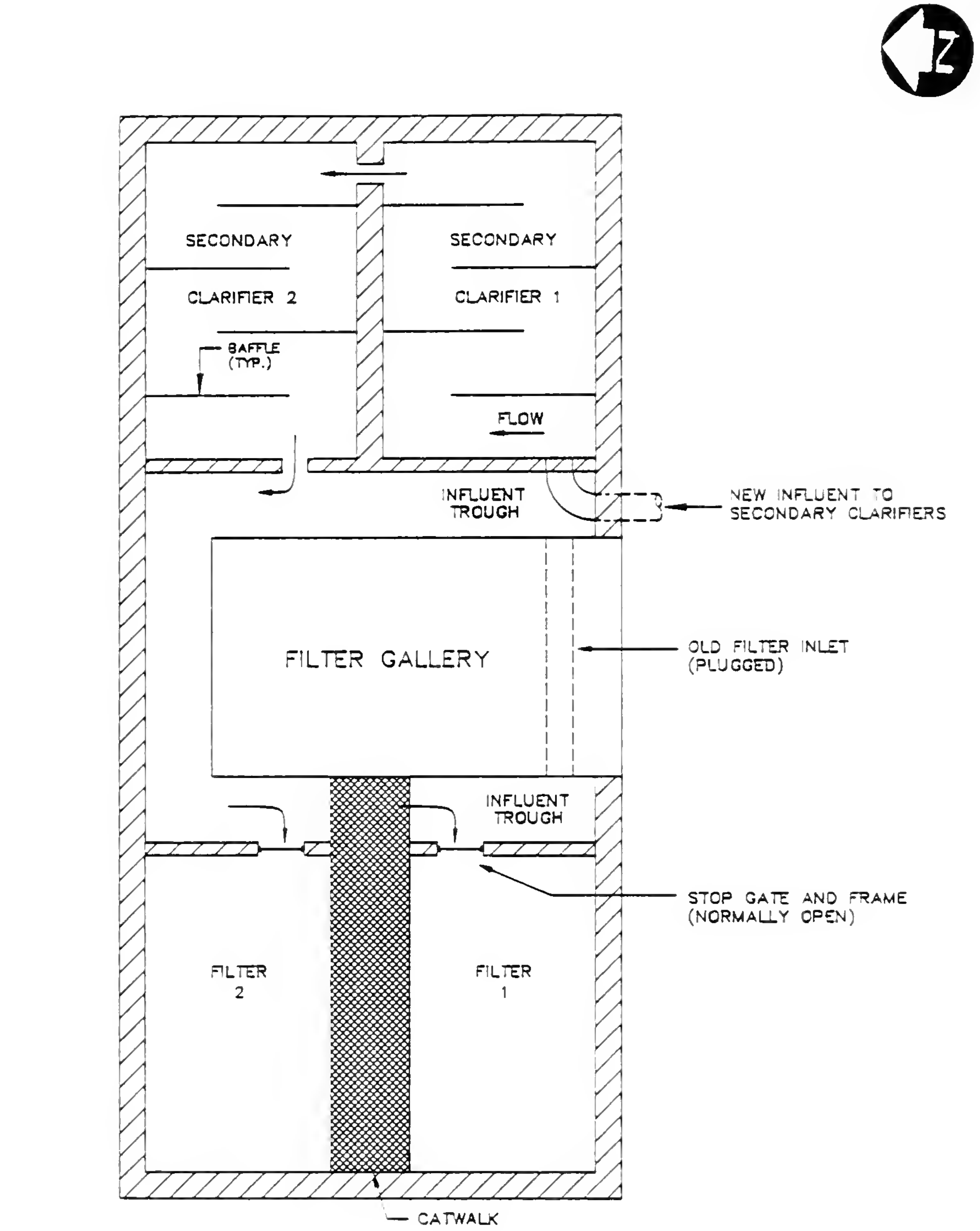
There is no stand-by pump.

C:3:g Secondary Clarifiers

In response to consumer complaints about taste and odour in the treated water, the two empty filters were converted to secondary clarifiers. Four wooden baffles were added to each empty filter (see Figure 9). The filter inlet was modified to permit clarifier effluent to be pumped to the secondary clarifier. Characteristics of the secondary clarifier are:

Dimensions:	4.57m x 2.44m x 3.86m depth
Volume:	43 m^3
Retention Time:	20 min @ design capacity
Velocity:	0.9 m/min @ design capacity

Since conversion of the empty filters to secondary clarifiers, there have not been any consumer complaints about taste and odour.



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FILTERS

FIGURE
9

C:3:h Filters

Number of Filters:	2
Type:	Dual Media Gravity Filters (anthracite, sand)
Size:	2.44m wide x 4.57m length x 3.96m deep (each filter)
Bed Depth:	Anthracite 457 mm (18") Sand 305 mm (12") Gravel 381 mm (15")
Volume:	44.16 m^3
Capacity:	At 5.86 m/hr (2 gpm/ft^2) = 3 ML/d (0.66 MGD) (both filters)

Backwash

One backwash pump is installed. The pump is:

Pump No.:	P8
Type:	Vertical Turbine
Manufacturer:	Crane Deming
Capacity:	63 L/s @ 7.62m TDH
Motor:	15 kW (20 hp), 1150 rpm

The backwash pump draws treated water from the high lift clearwell. Surface washwater is drawn from the backwash water line.

Surface wash is by rotating nozzles.

C:3:i Clearwell Storage

Filter Clearwell:	Location:	below filters
	Size:	5.18m x 7.01m x 3.43m water depth
	Volume:	124.6 m^3
	Retention time at Design Flow = 1 hour	

High Lift Clearwell:	Location:	adjacent to filter clearwell
	Size:	4.34m x 5.05m x 3.43m water depth
	Volume:	75.3 m^3
	Retention time at Design Flow = 36 min.	
Holding Tank:	Location:	below secondary clarifiers
	Size:	10.13m x 4.57m x 3.43m water depth
	Volume:	158.9 m^3
	Retention time at Design Flow = 1 hr. 16 min.	

All treated water storage tanks are interconnected by 300 mm diameter gate valves.

C:3:j High Lift Pumping

Pump No.	Capacity L/s	Head m	Type	kW	Motor Manufacturer
P4	30	46.6	Vertical Turbine	19	Johnston
P5	15	45.1	Vertical Turbine	11	Johnston
P6	45	45.7	Vertical Turbine	30	Crane Deming

Treated water can be pumped to the water storage tank or directly to Town. Normally, treated water is pumped to the storage tank.

If required, the backwash pumps can be used as high lift pumps to pump treated water to the distribution system.

C:3:k Backwash Water and Sludge Disposal

Clarifier sludge is automatically pumped to a sump in the basement from which it is pumped to the sanitary sewer.

Filter backwash water is also discharged to the sanitary sewer.

C:4 CHEMICAL SYSTEMS

C:4:a Organic Chemical Removal

Powdered Activated Carbon (PAC)

Brand of Chemical: Norit & Hydrodarco B

PAC is used mainly for adsorption of organic chemicals, but also helps to remove taste and odour.

Originally, bagged PAC was stored in a truck outside the WTP. PAC was supplied to the Dresden WTP and other WTPs in nearby

communities. Of the nearby communities, currently, PAC is only being supplied to the Mitchell's Bay WTP. Plans are being made to remove the truck once the stored PAC is used up.

PAC is purchased in 22 kg (50 lb) bags and stored in the room behind the low lift pump station.

The PAC application point used to be to the clarifier. PAC dropped in powder form into the clarifier. PAC powder tended to float on top of the clarifier, creating a health and safety problem. Also, addition of the PAC at this location blackened the clarifier room, so that constant maintenance was required to keep this room clean.

In 1987, the PAC system was moved to the low lift pump station. A PAC slurry tank was installed in the room behind the pump room.

PAC is made into a slurry with raw water pumped into the slurry tank by Nabisco's pumps.

Slurry Tank:	Material:	FRP
	Dimensions:	1.14m diameter x 1.22m high
	Volume:	1.25 m^3

From this tank, PAC slurry flows by gravity into a day tank in the low lift pump room.

Day Tank:	Material:	FRP
	Dimensions:	0.8m diameter x 1.07m high
	Volume:	0.54 m^3

PAC slurry is pumped by metering pump from the day tank into an injection tee in the raw water line downstream of the low lift pumps.

Metering pump feed rate is manually selected. The pump is interlocked with WTP start-up/shut-down.

C:4:b Taste and Odour Removal

Potassium Permanganate

Mixing Tank:	Dimensions:	0.635m diameter x 0.914 high
	Volume:	0.29 m^3

Potassium permanganate is delivered in drums in powdered form and stored in the Chemical Storage Room. It is made up into solution by adding 0.5 kg to a dissolving tank. Potassium permanganate solution is pumped from the tank to a funnel, from which it flows by gravity to the flocculation zone of the solids contact clarifier. Control of the system is on-off with plant start-up/shut-down, with manually set feed rate.

C:4:c Coagulant

Chemical Used:	Bagged dry alum
Feeder:	Infilco Type EE4 Volumetric Feeder
Metering Pump:	Pumps & Softener Canada Ltd. Dual Jet Motor: Franklin Electric 0.25 kW (1/3 hp), 3450 rpm

Bagged dry alum is used for coagulation. Alum is shipped in 22 kg (50 lb) bags and stored in the Chemical Storage Room. Alum is fed into a hopper in the Chemical Storage Room. The hopper drops the alum into the Infilco volumetric feeder, which meters alum into a solution pot, where the powder is mixed with water. Mixing is achieved only by the turbulence of the water jet hitting the alum slurry. A feed pump pumps the alum solution into the raw water line feeding the flocculator. Mixing of the alum solution with raw water is dependent on turbulence in the pipeline.

The feed pump is piped to two Infilco feeders. One feeder is maintained as a stand-by alum feeder, used when raw water quality deteriorates and additional alum is required for coagulation.

Dosage of alum is set on a scale on the volumetric feeder at 0 to 100 per cent of full stroke. The scale on the feeder used to be calibrated to a graph. Plant staff report that parts on the feeder are so worn, that the feeder cannot be re-calibrated to the graph. Furthermore, feeder parts can no longer be purchased and have to be fabricated by plant staff.

Plant staff monitor treated water turbidity and vary feeder setting based on the turbidity of the treated water.

The alum feed system is interlocked with the start-up/shut-down of the WTP.

C:4:d Coagulant Aid

Activated Silica

Chemicals Used: Sodium Silicate and Sodium Bicarbonate

Dosing Tanks:

Sodium Silicate
Size: 0.508m diameter x .457m high
Volume: 0.0927 m^3

Sodium Bicarbonate
Size: 0.946m x 0.946m x 1.25m high
Volume: 1.11 m^3

Activated Silica
No. 2
Size: 2.01m x 2.01m x 1.08m high
Volume: 4.37 m^3 each tank

Sodium silicate is purchased in drums and stored on the main floor. Sodium silicate is pumped from the drum to a mixing tank on the upper floor.

Sodium bicarbonate is supplied in 22 kg bags. Bags are stored in the Chemical Storage Room in the upper floor. As required, sodium bicarbonate is made up into a solution in a day tank. The sodium bicarbonate solution is made up by mixing two bags of powdered sodium bicarbonate in 1.11 m^3 of water.

Activated silica is made up by mixing:

1 tank sodium silicate
½ tank sodium bicarbonate solution
2140 L water

in Activated Silica Tank 1. The solution is then pumped to Activated Silica Tank 2. The activated silica solution is then pumped from Activated Silica Tank 2 to a funnel from which it flows by gravity to the flocculation zone of the clarifier. The pump feeding activated silica is interlocked with plant start-up and shut-down.

Lime

Lime is used in the winter as a weighting agent to improve settling.

Bagged (22 kg) dry hydrated lime is stored in the Chemical Storage Room. An Infilco volumetric feeder is used to mix the lime into slurry. The bagged lime is emptied into a hopper which drops lime into the feeder. When the plant starts up, the feeder meters the powder into a slurry pot. Water is added and the turbulence of the water jet is used to mix the powder into a slurry. The lime slurry flows by gravity to the flocculation zone of the clarifier.

Like the alum feeder, a scale on the lime feeder can be set at 0 to 100 percent full stroke. This adjustment allows plant staff to vary the dosage. As discussed in the section on

alum, it is not possible to calibrate the feeder. The stroke setting is based on staff experience with the system and is adjusted as raw water quality changes.

C:4:e Disinfection

Chemical Used:	Chlorine gas
System:	2 - 70 kg chlorine cylinders to solution feed chlorinator
Chlorinators:	Capital Controls
Dosage Points:	Clarifier effluent chamber and High lift clearwell
Control:	Chlorine injector water supply interlocked with plant start-up/ shut-down Dosages set manually

A chlorine detector is located inside the chlorine room. This location does not permit external monitoring of the chlorine detector. Plant staff report that a new chlorine detector, with remote sensor, is on order. The new chlorine detector will be installed outside the chlorine room.

C:5 SAMPLING

Sample	Source
Raw water	Low lift pump
Settled water	Filter influent channel
Treated water	High lift discharge pipe/plant service water

Raw water from the low lift well is sampled when the low lift pump is operating. The sample line is on the low lift pump.

Settled water is sampled as it enters the filters, downstream of the "secondary" clarifiers.

Treated water is sampled in the laboratory from the plant service water supply.

C:6 PROCESS AUTOMATION

The WTP starts and stops automatically, based on the level in the high lift clearwell. Level sensing electrodes in the high lift clearwell are interlocked with the low lift pump starter which starts and stops the duty pump (P2). The electrodes are also interlocked with the solids contact clarifier sludge blowdown system and the chemical systems.

Clarifier sludge is automatically discharged from the solids contact clarifier. Originally, clarifier sludge was removed through a 75 mm sludge blowdown pipe (see Figure 8). An adjustable percentage timer operated a solenoid valve on the blowdown pipe to control sludge discharge. Power to the timer was fed from the low lift pump station. The timer started with the low lift pumps and operated 15% to 100%, as set by the operator, of operating time.

Hardness in the raw water caused scale formation on the blowdown pipe. The scale has built up and the pipe is now about 10% of its original diameter. In 1984, two submersible sludge pumps and new blowdown pipes were installed in the solids contact clarifier. Sludge is pumped to the clarifier overflow pipe and is discharged to the sanitary sewer. The sludge pumps are started and stopped by the original percentage timer.

A hydraulically activated rotary valve controls the Clayton level control valve, located at the discharge end of the clarifier effluent pump. The position of the Clayton valve (open or closed), as controlled by the rotary valve, controls pumping (on/off) to the secondary clarifiers.

A Honeywell bubbler modulates a filter effluent butterfly valve to maintain a constant level in the filter influent channel.

The high lift pumps start automatically to maintain a level in the water storage tank. The operating level in the water storage tank is the top few feet of the tank. This maintains a pressure of 345 to 415 kPa (50 to 60 psi) in the Town's water distribution system.

C:7 STAND-BY POWER

No stand-by power supply exists at the plant. If power supply to the treatment plant is cut off, a portable generator can be obtained from the City of Chatham. WTP staff report that this generator can be transported to site within a day's notice. While the plant is down, the Town relies on water stored in the water storage tank.

D: PLANT OPERATION

D:1 GENERAL DESCRIPTION

D:1:a General

The Dresden Water Treatment Plant is a conventional plant consisting of:

- flocculation/sedimentation in an Infilco solids contact clarifier retrofitted with settling tubes
- Dual media gravity sand filtration.

Chemical systems consist of:

- alum, activated silica and lime addition (winter only) for coagulation
- potassium permanganate for taste, odour and colour control
- powdered activated carbon for taste and odour control and adsorption of organic chemicals
- disinfection by chlorination.

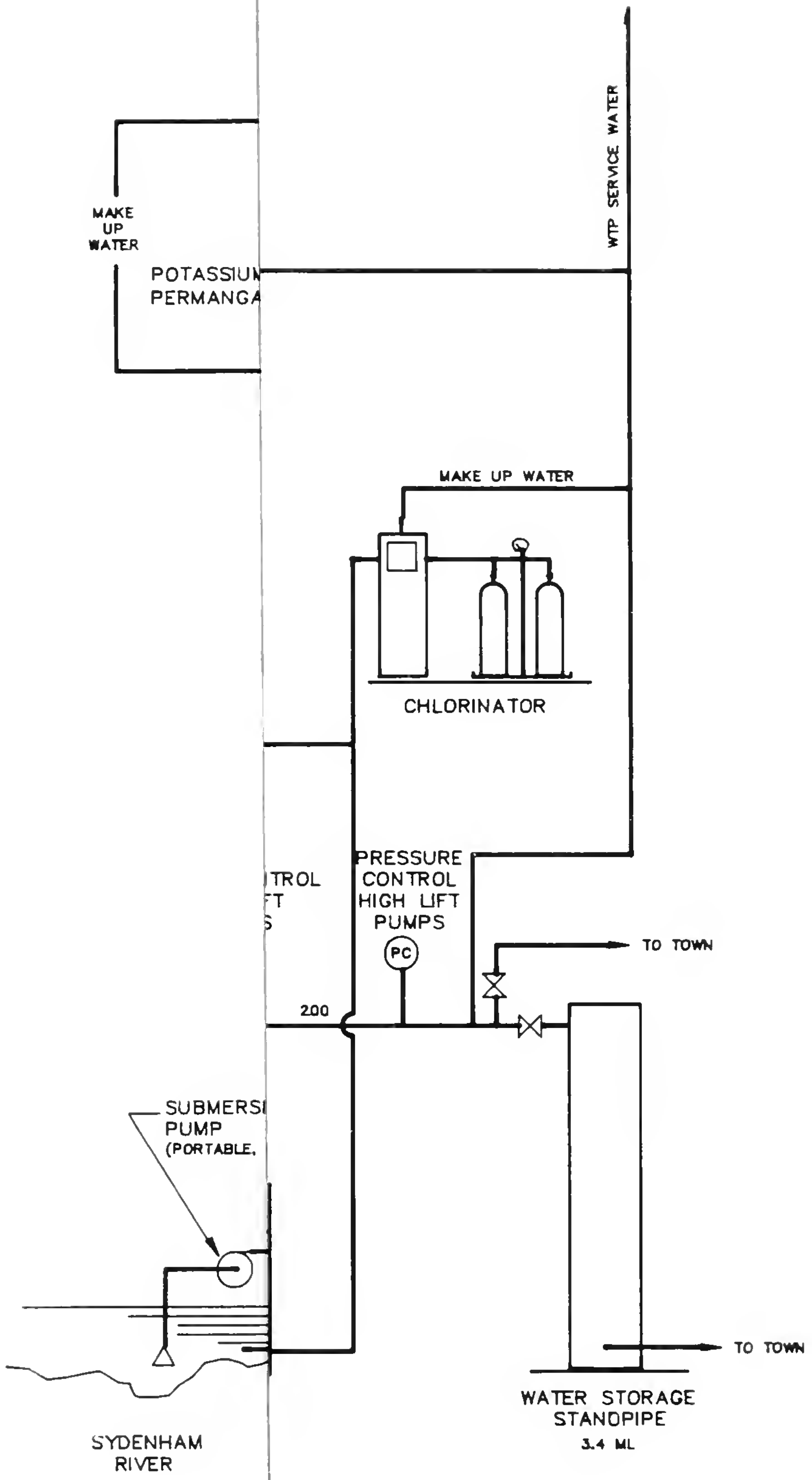
A process and instrumentation diagram is shown in Figure 10.

The Dresden WTP has a rated capacity of 3 ML/d. Maximum day demands over 4 ML/d have been reported in plant operating data.

D:1:b Operation

Three operators and a superintendent operate the Town's sewage and water treatment plants. On a rotational basis, one of the three operators operate the water treatment plant.

The plant can operate 24 hours/day, but is manned eight hours daily, including weekends. One member of the water treatment plant staff (on a rotating basis) is on call when the plant is



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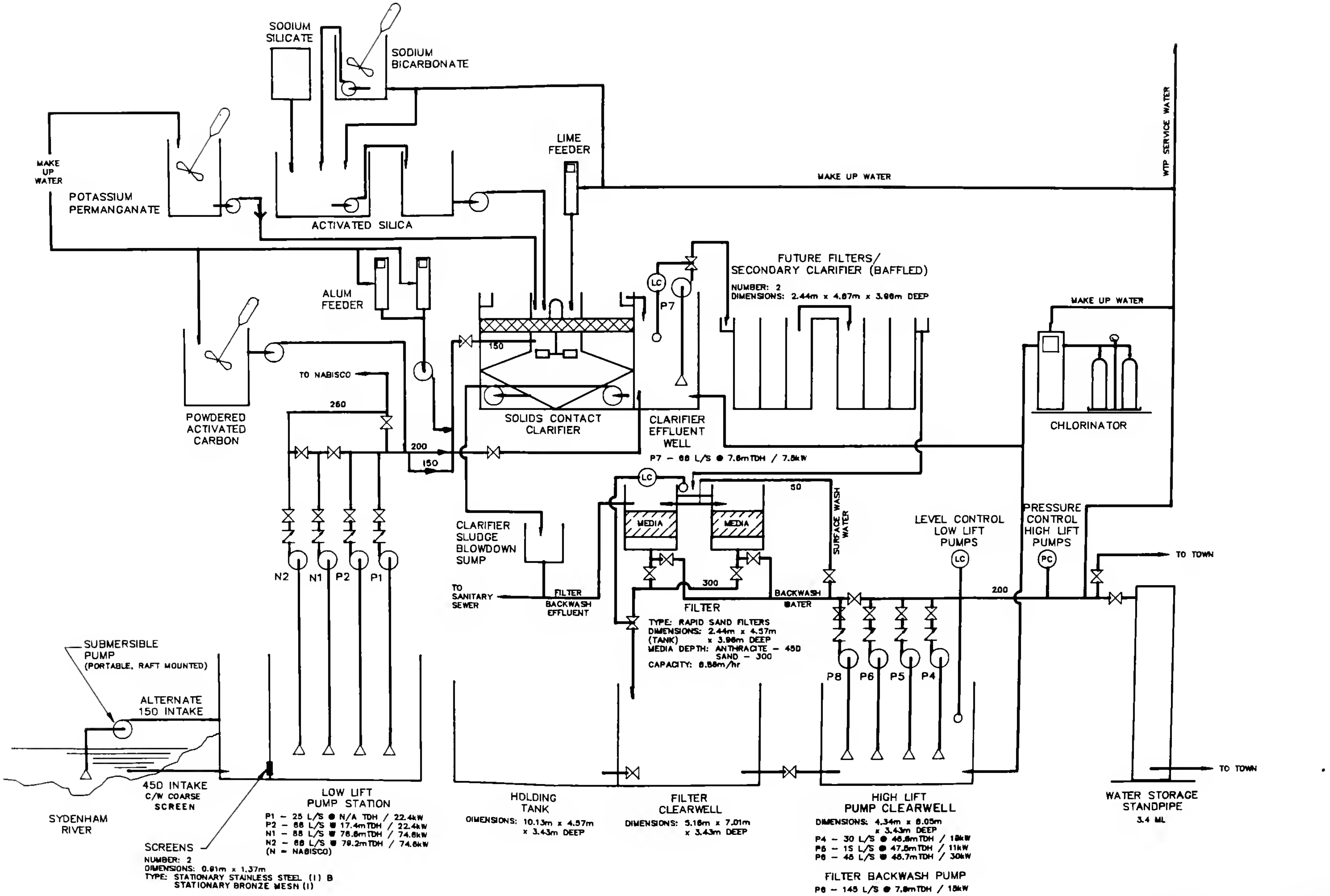
DRESDEN WPOS
PROCESS & INSTRUMENTATION DIAGRAM

FIGURE
10



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DRESDEN WPOS
PROCESS & INSTRUMENTATION DIAGRAM

FIGURE 10

unmanned. An alarm system is connected to an automatic telephone dialler which dials a pager system to alert the staff on call of a problem at the plant. Alarm conditions are:

- high water level in the clarifier effluent chamber
- low water level in the high lift clearwell
- low instrument air pressure (supply to pneumatic controls)
- low distribution system pressure
- high water level in the filter influent channel
- low level in the clarifier
- chlorine leak
- high turbidity in the effluent (set at 0.6 NTU)
- low temperature in the water storage tank monitoring building.

The dialler continuously calls, in order:

- the pager system (i.e., the operator on call)
- the plant superintendent's home
- the sewage treatment plant

until it is switched off. The pager service monitors the time of calling and if the dialler is not switched off (i.e., call has not been answered), the service will call the police department.

D:2 FLOW CONTROL

Raw water flow, along with operation of the chemical systems and clarifier blowdown, is controlled by water level in the high lift clearwell. Only one low lift pump operates; if both low lift pumps operate, the clarifier overflows.

Flow to the secondary clarifiers and filters is controlled by a Clayton valve, which controls flow from the clarifier effluent pump. Based on the level in the secondary clarifier, the valve is either open or closed so that flow is either on or off.

A butterfly valve in the common filter effluent line controls effluent discharge from the filters to the clearwell to maintain a constant water level in the filter influent channel. The level sensor is a bubbler system.

D:3 DISINFECTION PRACTICES

Prechlorination and post-chlorination facilities were installed in the WTP. Prechlorination at the low lift well was removed to reduce the formation of trihalomethanes (THM). THM's form in a reaction of chlorine with humic substances in raw water.

Currently, chlorine solution is added at two locations: prechlorination of settled water to inhibit growth of organisms in the filter media and post-chlorination of the treated water to ensure disinfection. The settled water is prechlorinated in the clarifier effluent chamber. Treated water is chlorinated in the high lift pump clearwell.

The chlorinator starts when the low lift pumps start. Chlorine is supplied from chlorine gas cylinders. Chlorine dosages are set manually by the operator based on experience and expected water demand. Dosages are changed when metered treated water flow changes. Since March 1989, when the treated water flowmeter broke down, there has been no flow measurement. Chlorine dosages have been set to maintain the desired treated water chlorine residual. Chlorine residuals are measured at least four times daily and chlorine dosages adjusted, manually, as required.

During the study period, post-chlorination dosages and residuals were:

	Range	Average
Chlorine dosage (mg/L)	0.48-8.64	1.8
Total chlorine residual (mg/L)	0.30-2.00	1.08

Table 3.0 in Appendix IV gives monthly ranges for chlorine dosage and demand during the study period.

Data shows that higher dosages were required in the summer months to obtain the desired chlorine residual.

It is expected that under warm water conditions experienced in the summer bacterial growth in surface waters will be higher, requiring larger quantities of chlorine for disinfection. Table 3.2 in Appendix IV presents a disinfection profile for January, April, July and October during the study period.

D.4 OPERATION OF SPECIFIC COMPONENTS

D:4:a Intake

The 450 mm intake is normally used. Although the intake is shallow (pipe invert is at 173.2m and average water level is at 175.1m), frazil ice has not been a problem at the intake. There has not, reportedly, been any silting of the intake pipe. Occasionally, usually after storm events, large debris, such as tree branches and stumps, become lodged in front of the intake pipe. Such debris must be manually removed. The WTP has access to a boat from the fire department which operators can use to remove debris.

The intake is regularly inspected for debris and cleaned as required.

A 150 mm intake is also available for when the river water level falls below 173.2m. A submersible pump is maintained at the WTP to pump into this intake. The intake has been used once, in 1962.

D:4:b Screening

The two 0.91m x 1.37m screens prevent debris from entering the WTP. Only one screen is used at any time. The other is suspended just below floor level of the low lift pump station.

Staff report that the new stainless mesh screen is only used during periods of low water demand. During periods of high water demand, for example, during Nabisco Brands canning season, the bronze mesh screen is used because it allows a larger flow into the plant.

Screens are inspected monthly and cleaned, as required. The normal cleaning routine is:

1) Lower off-duty screen,
2) Lift duty screen above floor level with winch,
3) Push screen to wash trough,
4) Lower screen to floor,
5) Hose down screen,
6) Remove and dispose of any debris in the floor drain strainer.

As-Constructed Drawings show washwater exits the pump station via a floor drain connected to a 150 mm cast iron pipe which empties to the Sydenham River (downstream of the inlet pipe). Plant staff report that the floor drain empties back to the low lift pump well. It is inappropriate to discharge screenings back into the low lift pump well. Plant staff should verify the floor drain discharge. If it is not as per

As-Constructed Drawings, the floor drain should be connected to the sanitary sewer.

Recently, the floor drain has become clogged with mud and debris. If cleaning is required, the screen must be carried outside to hose down. Screens are large, heavy and difficult to move. Two people are required when the screens are cleaned.

D:4:c Low Lift Pumps

There are two low lift pumps. One (P1) pump is 38 L/s (600 USgpm) and the other pump (P2) has a capacity of 58 L/s (916 USgpm). P2 is throttled to operate at 44 L/s (700 USgpm). P2 was installed in the WTP in June 1989 after the original pump broke down. It is used as the duty pump. P1 is the stand-by. Plant staff report that some repairs are required to P1 to make it fully operational.

The stand-by pump must be manually started, should the duty pump fail or not start.

Pump start and stop is based on the level of the high lift clearwell.

There is no low lift pump failure alarm. A low level alarm at the solids contact clarifier is the earliest process alarm. The operator must trace the problem from the solids contact clarifier back to the pump station. Plant staff plan to install a low lift pump failure alarm when the new raw water flow meter is installed.

Plant staff report that, in the summer, the temperature in the pump station increases to such an extent that the duty pump overheats and stops. To alleviate this problem, staff leave windows and doors open and operate a portable fan to maintain

cooler temperatures. Leaving windows and doors open could lead to vandalism. Proper ventilation of the pump station is required.

If water demand increases beyond capacity of the low lift pumps, the pumps supplying Nabisco Brands (2 - 68 L/s pumps) can be valved to augment the Town water supply. However, operating all pumps would cause the clarifier to overflow.

There are two raw water lines from the low lift pump station to the WTP. The 150 mm diameter pipe was installed with the original plant. A 200 mm diameter pipe was added in the 1980's to provide additional capacity.

Plant staff report the 150 mm pipe is used in parallel with the 200 mm pipe, but, is deteriorated and probably leaks. Plant staff report that use of the 150 mm pipe alone would not meet water requirements and that excessive pressure on this pipe, if used alone, would probably cause it to collapse. The Town's Public Utilities Commission is addressing this problem and intends to repair or replace this pipe.

D:4:d Flash Mixing

Alum solution is injected into the raw water upstream of the clarifier. Only the turbulence of the raw water flow provides mixing. No in-line mixer is provided. Alum solution has only seconds of "mixing" time before entering the flocculation basin.

Originally, chemical dosages were proportioned on raw water flow. However, the flow proportioning meter has broken down and repeated attempts to repair and replace the meter have not been successful. Thus, chemical dosages are selected manually. Usually, dosages are changed when treated or raw water quality deteriorates and are based on the operator's experi-

ence of required dosages. Jar tests are seldom performed. Since no calibration curves are available for chemical feed systems, it is difficult to relate optimum dosage obtained by jar testing with chemical feed rates. Also, since retention time in the plant is short, staff report about 20 minutes based on dye trace studies, jar tests bear little relationship to plant operation.

D:4:e Solids Contact Clarifier

General

The solids contact clarifier combines flocculation and sedimentation. These units are designed to maintain a large volume of flocculated solids in the system, which enhances flocculation of incoming solids, since there are more inter-particle collisions.

Present water demands, 3 ML/d, overload the unit, which has a design capacity of about 2.3 ML/d.

Flocculation

Raw water (with PAC and alum) enters the flocculation zone via a 150 mm diameter inlet pipe. Here, it mixes with previously formed floc, potassium permanganate, activated silica and, in the winter, lime. In the winter, alum is not dissolved and may not have sufficient time to dissolve and react in the cold water. Little floc is formed, so the operator recirculates filter backwash water to the flocculator to maintain a higher concentration of floc.

The mixing intensity is changed by adjusting a dial on the motor of the rotor. Normally, the dial is set at a low speed (1 to 2) and the tank contents are cloudy. During our site visit, flocculator speed was increased to a setting of 4 to 5, for a short period. The clarifier effluent improved markedly

in clarity. The flocculator was returned to its original low speed. Concern over floc shear was cited as the reason.

<u>Sedimentation</u>

To improve sedimentation, plastic settling tubes were installed in the sedimentation portion of the solids contact clarifier. The tubes are over 20 years old and broken, so that parts of the settling surface no longer have functional tube settlers.

During operation, pieces of tube often break off and clog openings, further reducing effective tube settler capacity. Sludge collects on top of broken pieces of tubing. Staff empty the sedimentation tank once per week to clean out the tubes. Staff report that it is difficult to lift and clean out the tubes without more breakage occurring. New settling tubes have been ordered.

The clarifier tank is overloaded. When water demand exceeds clarifier capacity, some of the contents overflow into the clarifier overflow pipe (see Figure 8).

Clarifier sludge is pumped out automatically. A percentage timer interlocked with plant start-up activates submersible sludge pumps in the clarifier. The timer is adjusted to maintain 10 to 15 per cent settleable solids in the flocculation zone. The pumps lift sludge up to the clarifier overflow pipe, which is connected to the sanitary sewer.

D:4:f Clarifier Effluent

Clarifier effluent flows to the clarifier effluent chamber. It is chlorinated and pumped up to two empty filters, which have been converted to secondary clarifiers.

D:4:g Secondary Clarifiers

The baffled secondary clarifiers provide the additional retention time required to further reduce filtered turbidity and for taste and odour removal.

During the site visit for the study (June 1989), light fragile floc were observed in the effluent from the secondary clarifier. These were carried through to the filters.

The secondary clarifiers are cleaned seasonally.

D:4:h Filters

Flow rate through the filters is determined by the clarifier effluent pump. The butterfly valve in the filter effluent pipe modulates to maintain a (more or less) constant water level in the filter influent channel.

Pumped flow from the clarifier effluent pump is controlled by a Clayton valve which is open or closed, depending on the water level in the clarifier effluent chamber. This manner of operation results in intermittent flow to the filters. Although some dampening of this fluctuating flow occurs in the secondary clarifier, the flow rate to the filter fluctuates, as does the water level in the filter influent channel.

In response to the change in water level, the filter effluent valve modulates in an effort to maintain a constant filter water level. However, this causes the flow rate through the filter to fluctuate rapidly and can result in turbidity breakthrough.

The flow rate through the filter should be constant or, at worst, slowly changing. The Clayton valve should be controlled to provide a constant flow to the secondary clarifiers and filters.

Filter Backwashing

Filter backwash is usually initiated daily in the summer and two to four times daily in the winter and spring. Initiation of backwash is based on effluent turbidity; if effluent turbidity deteriorates, backwash is initiated.

The shorter filter runs in the spring are due to spring storms which cause river water to become very turbid. Flocculation and settling in cold water conditions are difficult.

Since water in the winter is colder, alum takes longer to react. Since retention times are short in the solids contact clarifier, it is probable the floc formation carries over to the secondary clarifier. Formation of tiny, light floc has been observed exiting the secondary clarifier.

Backwash must be started and stopped manually and thus is dependent on the operator schedule.

The backwash procedure is as follows:

1) Switch off high lift pumps,

2) Drop filter influent slide gates to prevent flow from reaching the filter being backwashed,

3) Open backwash drain valve to allow backwash water to flow to the sanitary sewer,

4) Close filter effluent valve to prevent filter water from going to clearwell,

5) Open backwash inlet valve to allow backwash water to enter filter,

6) Open surface wash valve to allow water into surface wash piping,

7) Turn on backwash pump,

8) Adjust backwash throttling valve to obtain the desired rate of overflow over weirs into the effluent trough.

Steps 1 to 5 are conducted on the main floor and Steps 6 to 8 are carried out on the upper floor in the Filter Room. Step 1 is carried out to prevent the high lift pumps from starting up while filters are being backwashed. Simultaneously operating the high lift pumps and conducting a backwash causes the clearwell to be drawn down too low, which results in a low level alarm.

Backwashing continues until the overflow is clear. This is based on a visual inspection by the operator. Usually, depending on how dirty filters are, backwashing takes approximately 20 minutes. When the operator is satisfied that the backwash water is sufficiently clear, the following steps are taken to terminate backwashing:

1) Close surface wash valve,
2) Close backwash drain valve to sanitary sewer,
3) Allow backwash pump to continue pumping treated water up through the filters to bring the water level in the filters up to normal operating levels,
4) Switch off backwash pump,
5) Open filter influent slide gate to permit clarifier effluent to enter filter,
6) Open filter effluent valve to allow filtered flow into clearwell,
7) Close backwash inlet valve,
8) Open backwash throttling valve,
9) Switch high lift pumps back to automatic.

Step 2 and 5 to 8 are conducted on the main floor. Steps 1, 3, 4 and 8 are conducted on the upper floor in the Filter Room.

Filter backwashing is an arduous process. All valves are manually operated. The operator must run from main floor to upper floor three times to completely backwash one filter.

The operator times filter backwashing to fit into his schedule of daily operations and maintenance, and to maintain sufficient water in the clearwell to meet water demand. Therefore, usually one filter is backwashed in the morning and the other filter is not backwashed until much later in the day. Thus, the flow rate through the dirty filter decreases.

Backwashing is neither timed nor monitored for turbidity change to determine when backwash will be terminated. Often the operator carries out other duties and allows backwash to be carried on much longer than necessary. Thus, more treated water is used for filter backwashing than may be required.

There appears to be no loss of media during filter backwash. Plant staff report that filters are inspected annually. Filter inspection is usually carried out when Nabisco Brands take a break in production. At this time, filters are cleaned and the media is brought up to design levels. When filters are cleaned, staff report that mudballs have been found. Mudballs are a sign of ineffectively cleaned filters. Usually, mudballs form at the surface of the filter due to poor surface wash. Small particles fall through the filter, growing into mudballs as dirt and slime collect on the mudball.

At the Dresden WTP, surface washwater is drawn from the backwash line. Pressure is too low to obtain a good surface wash. Surface washwater should be taken off the treated water line.

The water level in the operating filter is observed to rise when the other filter is being backwashed.

There is no filter-to-waste after backwashing. The initial water filtered after a backwash may be turbid and, therefore, should be wasted until the effluent turbidity is acceptable.

D:4:i Clearwell Storage

Filter effluent goes to the filter effluent clearwell and then to the high lift clearwell. Chlorine solution is added to the high lift clearwell for disinfection.

The clearwell is inspected regularly and cleaned, as required, by plant staff. When cleaning is required, treated water in the well is transferred to the water storage standpipe, the plant is switched off and the well hosed.

The electrode system in the clearwell, which transmits signals for plant start/stop to the high lift and low lift pumps and the chemical feed system, corrodes and fails to operate. Regular cleaning is required.

D:5 CHEMICAL SYSTEMS

Chemical usage during the study period is reported in Table 2.0 and Table 2.2 in Appendix IV. Dosage range is reported herein for each chemical.

D:5:a Organic Chemical Removal

Powdered Activated Carbon (PAC)

PAC is used for removal of organics, but also provides taste and odour control. PAC slurry is prepared by adding 1-22 kg sack of PAC to 1250L of raw water. PAC slurry is transferred by gravity to a day tank, from which it is pumped into the raw water pipe exiting the low lift pumps.

The metering pump starts when the plant starts up. Plant staff must manually alter the feed rate in response to changes in treated or raw water quality.

PAC dosage is calculated from the weight of PAC used and the treated water metered daily. During the study period, for months during which PAC was used, daily dosages ranged from:

	Minimum	Maximum	Average
Dosage (mg/L)	4.6	59	21

D:5:b Taste and Odour Removal

Potassium Permanganate

Potassium permanganate is used for taste and odour control. Potassium permanganate is made up into solution from powder. The solution is made up by adding 0.5 kg of powder to a constant level dissolving tank and dissolved by a stream of water entering the tank.

The solution is pumped from the tank into a funnel, from which it flows by gravity into the flocculator. Plant staff monitor the potassium permanganate solution entering the funnel. When the purple solution becomes transparent, additional potassium permanganate is added to the tank.

The pump is set to start when the plant starts up and a constant volume of solution is pumped out. The operator manually changes the volume of solution pumped in response to a change to raw and/or treated water quality deteriorates.

Dosage is calculated from the weight of potassium permanganate added daily to make up the potassium permanganate solution, and the treated water metered daily.

During the study period, daily dosages ranged from:

	Minimum	Maximum	Average
Dosage (mg/L)	0.1	1.4	0.4

D:5:c Coagulant

Dry powdered alum is used for coagulation.

Alum is dumped into a hopper, located in the Chemical Storage Room on the upper floor, which feeds the volumetric chemical feeder on the main floor. In the feeder, the alum is metered into a stream of treated water. The alum solution is pumped into the raw water line entering the flocculator.

Daily alum dosages are calculated from the number of 22 kg (50 lb) bags of alum used and the metered treated water produced daily. Since March 1989, the treated water meter has been inoperative and alum dosages have been recorded as the number of bags of alum used daily.

During the study period, alum dosages ranged from:

	Minimum	Maximum	Average
Dosage (mg/L)	5.1	497	47

D:5:d Coagulant and Settling Aids

Activated Silica

Activated silica, a blend of sodium silicate and sodium bicarbonate, is used as a coagulant aid.

Activated silica is made up of:

	Percentage (by volume)
Sodium Silicate	3
Sodium Bicarbonate Solution	20
Treated Water	77
	100

Sodium bicarbonate solution is prepared from two 22 kg (50 lb) bags and 1110L (245 Ig) of treated water.

Activated silica is dosed at the flocculator of the solids contact clarifier. A metering pump draws activated silica from Tank No. 2, lifts activated silica to a funnel from which it flows by gravity to the flocculator.

Activated silica dosage is reported as sodium silicate and sodium bicarbonate dosages. Dosages are calculated based on the volume of activated silica used daily and the metered treated water produced daily.

During the study period, dosages ranged from:

	Dosage (mg/L)		
	Minimum	Maximum	Average
Sodium Silicate	1.0	103	7.7
Sodium Bicarbonate	0.8	25.4	6.4

Dosages must be changed manually, as required. Dosages are changed by changing the activated silica pump rate. Operators do not change the pump rate unless there is a marked change in raw or treated water quality.

Lime

Hydrated lime is added in the winter to weight floc and thus improve floc settling. Powdered lime is dropped into a hopper and falls into an Infilco volumetric feeder. Here, the powder is metered into a stream of water. The lime slurry is fed by gravity into the flocculator zone of the solids contact clarifier.

The feeder starts when the plant starts up and delivers a constant volume of lime slurry to the flocculator. The lime feed rate into the water stream can be adjusted by changing

the stroke setting of the feeder. The operator adjusts the lime feed rate in response to variation in raw or treated water quality.

Lime dosage is calculated from the weight of lime used and the treated water metered daily.

During the study period, in the months during which lime was used, daily dosages ranged from:

	Minimum	Maximum	Average
Dosage (mg/L)	1.1	95.4	11

D:6 SAMPLING AND DATA COLLECTION

The following lists tests performed at the plant:

Test	Sample	Sample Location	Test Frequency	Instrument
Cl_2 Residual: Free and Total	Clarifier Effluent	Filter Inlet	4/day	DPD Comparator
	Treated Water	Laboratory Service Water	4/day	"
	Treated Water - Distribution System	Homeowner Tap	1/day	" "
Turbidity	Raw Water	Low Lift Pump	1/day	Hach Turbidimeter (laboratory)
	Clarifier Effluent	Filter Inlet	2/day	" " (in-line)
	Treated Water	Laboratory Service Water	2/day	" " (laboratory)
	Treated Water Distribution System	Homeowner Tap	1/day	" " (laboratory)
Temperature	Raw Water	Low Lift Pump	1/day	Thermometer
	Treated Water	Laboratory Service Water	1/day	"
	Treated Water Distribution System	Homeowner Tap	1/day	"

Test	Sample	Sample Location	Test Frequency	Instrument
pH	Raw Water	Low Lift Pump	1/day	Colourimetric
	Treated Water	Laboratory Service Water	2/day	"
	Treated Water - Distribution System	Homeowner Tap	1/day	"
Settleable Solids	Flocculated Water	Flocculator Section of Solids-Contact Clarifier	1/day	1000 mL Graduated Cylinder

There is no sampling schedule. Sampling is conducted at the convenience of the operator. No attempt is made to capture the same block of treated water after raw water sampling. Raw water sampling is sometimes conducted after treated water sampling. This is not in accordance with proper sampling protocol. Raw water should be sampled first, and settled and treated water should be conducted after intervals which account for retention time in each process.

D:7 PROCESS AUTOMATION

The WTP starts and stops automatically. Level sensing electrodes in the high lift clearwell are interlocked to start the duty low lift pump (P2). Simultaneously, the chemical metering pumps and the chemical feeders are started.

An adjustable percentage timer on the solids contact clarifier sludge blowdown is interlocked with start-up of the duty low lift pump. The timer is wired to operate submersible sludge pumps in the clarifier. Setting on the timer can be varied between 15 to 100 per cent of a unit time. The operator adjusts the timer to maintain a 15 per cent settleable solids in the flocculation zone of the clarifier.

The operation of the clarifier effluent pump is controlled by the position of the Clayton valve located on the discharge of the pump. The valve is hydraulically actuated to open or close depending on the level in the clarifier effluent chamber.

The clarifier effluent pump must be manually switched off following a high level alarm in the filter influent channel.

Operation of the high lift pumps is automatic. The two duty pumps are interlocked with a pressure sensor at the water storage tank. Treated water is pumped to the water storage

tank to maintain a pressure of 345 to 415 kPa (50 to 60 psi) to the Town's water distribution system.

Operation of the stand-by low lift pump and emergency high lift pump are manually initiated.

D:8 DAILY OPERATOR DUTIES

Daily operator duties include:

- general inspection of the WTP and the low lift pump station,
- filter backwash,
- laboratory work,
- chemical make-up,
- monitoring and collecting data,
- altering chemical feed rates, as required,
- sample collection,
- cleaning and maintenance.

Laboratory work consists of:

- measuring chlorine residuals. Chlorine residuals are monitored in the filter influent, treated water leaving the plant and in the distribution system,

- measuring raw and treated water turbidity,

- measuring the settleability of the flocculator contents to estimate sludge wasting rates,

- measuring raw and treated water pH.

Chemical make-up includes:

- preparing PAC slurry (prepared every second day, usually),
- making up sodium bicarbonate solution (prepared on alternate days to above item),
- making up potassium permanganate solution,
- topping up alum in the chemical feeder,
- topping up lime in the chemical feeder (winter only).

The following data are recorded daily:

- weight of chlorine gas cylinders (to calculate chlorine usage),
- level in Activated Silica Tank 2 (to calculate volume of activated silica used),
- number of bags of dry alum used,
- number of bags of lime used (winter only),
- volume of potassium permanganate used,
- number of bags of PAC used,
- plant electrical consumption,
- pressure in water storage tank and distribution system,
- plant air pressure.

Samples are taken once weekly for bacterial analyses at the MOE laboratory in London and for pesticide analysis by the Ministry of Agriculture and Food.

Samples are taken monthly for physical, chemical and bacterial analyses at the MOE laboratory under the DWSP.

Any extra time during the day is spent on cleaning and maintenance. Regular maintenance items include:

- cleaning the intake screens,

- emptying and hosing the solids contact clarifier and settling tubes,

- flushing the activated silica lines with hot water to remove accumulated activated silica,

- general maintenance and cleaning of pump station, treatment plant and plant grounds.

At the end of each month, a summary of plant flows, chemical usage and dosages, and water quality are recorded on MOE Utilities Monitoring Reports (see Appendix II for sample).

To facilitate maintenance of an updated information base under the WPOS program, plant staff should record operating data under the format of the WPOS tables, as presented in Appendix IV.

E: PLANT PERFORMANCE

E:1 GENERAL

In general, the plant produces treated water which is acceptable to consumers. There have been no complaints about taste and odour in the treated water since the operators converted the two empty filters to secondary clarifiers.

E:2 TURBIDITY

During the study period, daily average turbidities monitored at the WTP usually achieved the MOE guideline of 1.0 FTU. Occasional exceedances in the daily average turbidities were measured in October and November of 1989 (ranging from 1.04 to 1.70) and January and March of 1987 (ranging from 1.07 to 9.58). Daily maximum turbidities exceeding the MOE guideline are tabulated in Table 7.0 in Appendix IV. Predominantly, exceedances occurred between January and April, and September and December.

The plant seldom produced water with a turbidity less than the MOE Southwestern Region Utility Operations objective of 0.2 FTU. During the study period, daily average turbidity met the Southwestern Region objective on 2 days in 1987, 90 days in 1988, and 30 days in 1989. There is no apparent correlation between seasons and low turbidity. No correlation is evident between treated water turbidity and treated water flow nor raw and treated water turbidity. There is little consistency in the quality of the water produced at the plant from day to day.

Because retention time in the sedimentation sections of the WTP is short, for consistency in treated water turbidity, coagulation and flocculation must be optimized. Coagulation is not an instantaneous reaction. Especially in cold water, it takes several minutes for the alum coagulation to complete. To ensure that reaction time is not hindered, it is essential

that rapid dispersion of alum solution and contact with the total raw water flow are achieved. Alum must be fully dissolved.

The Infilco chemical feeders do not fully dissolve alum. There is no mixing of alum and water in the slurry pot in the feeder, so some alum settles to the bottom and does not dissolve. Operators report that undissolved alum is periodically removed from the solution pot. Tests on dissolving alum in cold water (conducted at the lab during the study) showed that it takes as long as 15 minutes for powdered alum to dissolve in cold water when mixing is provided.

The alum solution from the Infilco feeder is pumped into the raw water flow at the inlet pipe to the flocculator. There is no in-line mixer; therefore, the alum solution may not contact the entire stream of water.

The retention time between the alum application point and flocculation tank is short; in the order of seconds. Therefore, it is probable that alum coagulation is not complete.

In the flocculator, the energy provided must be high enough to maximize particle collision to aid the formation of strong, dense floc. On the other hand, mixing must not be so fast that floc are broken by the action. The flocculator at the WTP is normally set at a very low speed. The effluent is cloudy. Any floc particles formed at the WTP appear light and fluffy and are slow settling.

Lime is added in the winter, to weight floc for better settling. Analysis of the WTP data during the period of lime addition show no increase in the pH of water when lime is used. Lime added is not dissolved. Tests conducted at the WTP during the study period show that, in cold water (5°C), more than 30 minutes work was required for lime to dissolve

when mixing was provided. Plant staff report that there is not 30 minutes retention time in the WTP (based on a dye tracing study). Also, since no mixing is provided in the Infilco feeder, lime either settles out in the feeder or in the solids contact clarifier.

Jar tests conducted at the WTP during the study produced large settleable floc and clear supernatant. The plant flocculator produces a cloudy water with slow settling, fragile floc. Floc is carried over to the secondary clarifier and to the filters, therefore, shortening filter runs.

Jar tests use dilute chemical solutions to aid in dispersion. Standard jar tests provide one minute of rapid mix and 30 minutes of slow mixing. These retention times are not available in the plant at present water demands. Also, without better methods of dosage determination and flow proportioned dosing of chemicals, jar testing to optimize coagulant dosages does not help the treatment process.

E:3 COLOUR

During the study period, the MOE guideline for colour, 5 Hazen Units, was exceeded on numerous occasions; these are tabulated in Table 7.0 in Appendix IV. There is no apparent correlation between raw and treated water colour.

Colour quality of the treated water should be monitored and potassium permanganate dosage increased, as required to meet MOE guidelines for colour.

E:4 TASTE AND ODOUR

As previously mentioned, there have not been any recent complaints of taste and odour problems from consumers.

Potassium permanganate is used in small quantities for taste and odour control. PAC is added for removal of organics, but also removes taste and odour causing substances. Therefore, use of potassium permanganate for this purpose may be redundant.

E:5 ORGANIC SUBSTANCES

PAC is used for the removal of substances, such as volatile substances and pesticides and herbicides which originate from agricultural run-off from the Sydenham River watershed.

The volatile organic compounds present in the treated water are mostly trihalomethanes (THM's). These are formed in a reaction of chlorine with organic matter in the raw water and will form after chlorination. THM's consist of:

- chloroform
- chlorodibromomethane
- dichlorobromomethane
- bromoform.

DWSP monitoring found levels of THM's to be below the ODWO of 350 ug/L. A summary of positive tests for THM's found by the DWSP is shown in Table VI.

Monitoring of treated water conducted under the Drinking Water Surveillance Program also found five pesticides above detection limits (see Table V). All were at concentrations below Ontario Drinking Water standards.

Review of plant data show that PAC use is increased in the spring/summer months, i.e., the growing season, when farmers are spraying vegetation. The practice of increasing PAC dosage at this time of the year should be continued.

E:6 SEDIMENTATION

Retention time in the sedimentation portion of the solids contact clarifier is short. The tube settlers aid in the removal of settleable solids. However, because tubes are old and brittle, pieces tend to break off, clogging portions of the tubes. Settling tubes should be replaced. Plant staff report that new settling tubes have been ordered.

TABLE IV

POSITIVE RESULTS OF DWSP TESTING FOR TRIHALOMETHANES IN THE TREATED WATER

Concentration (mg/L)

Trihalomethane	1987 June	1987 Nov	1986 Feb	1986 Mar	1986 Apr	1986 May	1986 June	1986 Dec	ODWO ($\mu g/l$)
Chloroform	90	50	55	53	110	82	93	55	
Dichlorobromomethane	18	17	20	8	21	16	27	18	
Chlorobromomethane	4	2.9	10	2	3	1	7	3	
Total Trihalomethane	112	69.9	85	63	134	99	127	76	350

TABLE V

RESULTS OF DWSP TESTING FOR SPECIFIC PESTICIDES IN TREATED WATER

Pesticide	Concentration (ng/L) 1987 June	November	1986 May	Limit of Detection (ng/L)	Health and Welfare Canada Guideline (ng/L)
Alpha BHC	BDL	!IS	BDL		700
Lindane	2.000<T	!IS	"		4 000
Atrazine	13900	BDL	1135	50	60 000
Bladex	3680	BDL	BDL	100	10 000
2,4-DP	BDL	!LA	"	100	N/A
Metolachlor	6650	BDL	"	500	50 000
Dicamba	480.000<T	!LA	"	100	87 000

BDL Below Detection Limit
<T Greater than Detection Limit, but not confident
!IT No data. Insufficient sample
!LA No data. Laboratory accident

Source: Drinking Water Surveillance Program, Annual Reports 1986 and 1987.

E:7 FILTRATION

From March to August 1989, filter runs were 24 hours. Data for this period in 1988 show similar run times. Shorter filters runs are experienced in the fall, winter and spring; filter runs vary from 6 to 24 hours, depending on treated water turbidity. Since there is no head loss measurement across the filter, staff monitor effluent quality to determine frequency of backwashing required.

Backwashing is manually initiated and is a labour intensive process. The operator must open and close valves on the main floor and on the upper floor to start and stop backwashing. There is no control of the backwash period. The operator starts a backwash, resumes his duties and then returns to stop backwash. As a result, backwashing may carry on longer than required, wasting treated water at 3800 Lpm (1,000 USgpm).

No apparent loss of media from the filter was detected during the study period. Plant staff report that the filters have not been graded nor topped up recently, but are usually cleaned once per year when Nabisco Brands undertake their annual shut-down.

E:8 DISINFECTION

Bacteriological analyses are conducted by the MOE London laboratory. Samples of raw and treated water, and a sample from the distribution system are taken once per week for testing.

The results of bacteriological testing on treated water and samples from the distribution system are presented on Table 6.0 and 7.1, respectively, in Appendix IV.

Chlorine solution is added to the treated water for disinfection. Chlorine dosages are set manually by the operator, based on experience. Since there is no flow proportioning of the chlorine added, chlorine dosage does not reflect instantaneous demand.

E:9 STAND-BY EQUIPMENT

One low lift pump operates to supply water demands; the other pump is a stand-by. The Nabisco pumps can be valved to supply the Town with water if one of the pumps is inoperative.

There is no back-up pump for the clarifier effluent pump. This is a critical concern because, should the clarifier effluent pump be out of service, the plant could not produce potable water. A back-up pump should be provided for the clarifier effluent pump.

There is no back-up pump for the backwash pump. Should this pump fail, the filters could not be backwashed. Provisions should be made for providing emergency backwash.

The high lift pumps are backed-up by the fire pump. In emergency conditions, the backwash pump can be valved and throttled to supply the Town with water.

No emergency generator is available at the plant in case of power outage. However, staff report that a portable generator can be borrowed from a few nearby communities.

Two emergency/stand-by compressors are available should the compressor, which runs the WTP's pneumatic controls, fail. The stand-by compressors are stored at the Town's sewage treatment plant.

F: PROCESS MODIFICATIONS

As discussed in the introductory section of this report, it is recognized that the Dresden WTP may be decommissioned once a pipeline from Lake Huron, with water treatment at another WTP, is in place. Therefore, the focus of recommendations are short term process modifications which are required for the Dresden WTP to be able to produce a more consistent treated water quality. During the course of the study, many non-process concerns, most of which concern health and safety for plant operators, were identified. These are also presented herein so that they may be modified to produce a safe working environment.

F:1 CHEMICAL ADDITION

Powdered Activated Carbon

The PAC system is a health and safety concern. There is no automatic feeder, bag slasher or dust collection system. Operators must lift the 22 kg PAC bags up three steps and over their heads, slash the bags open, and empty the contents into the mixing tank which is 1.2m high and supported on a 0.6m platform. No dust collection or ventilation of any type is provided in the PAC room. None of the wiring nor electrical equipment is explosion-proof. Carbon dust could ignite if there were a spark.

Presently, PAC is fed at a constant rate into the raw water line. Feed rates must be manually adjusted by plant staff in response to changes in treated water quality. PAC feed rates should be paced to match plant flow rate.

Recommendations:

<u>Short Term</u>

1) Construct a platform at truck-bed height to store PAC and to access the PAC mixing tank.

   Estimated cost = $2,000

2) All electrical equipment and wiring should be upgraded to explosion-proof rating.

   Estimated cost = $6,000

3) A dust collection system and proper ventilation of this room must be provided.

   Estimated cost of dust collection system = $15,000

   Estimated cost of ventilation system = $18,000

4) A raw water meter should be provided to permit flow pacing of PAC addition. Alternatively, a step feed controller can be added. This would increase flow from the chemical metering pump when the second low lift pump starts.

   Estimated cost = $1,300

<u>Alum</u>

The current alum system is not effective. Under normal operations, alum is not dissolved by the Infilco chemical feeder; some powdered alum remains undissolved at the bottom of the slurry pot in the feeder.

The injection point in the raw water line upstream of the flocculation tank does not give sufficient reaction time with

the raw water. In cold water, i.e., winter conditions, alum requires even longer reaction times.

Alum, like PAC, is fed at a manually selected fixed rate into the raw water line. Alum feed rates should be step paced.

The Infilco chemical feeders are outdated; operators cannot get spare parts for the feeder and must fabricate parts if they become worn.

Recommendations:

<u>Short Term</u>

1. The Infilco feeders should be removed.

2. Alum addition should be moved to the low lift pump discharge line at the low lift pump station to increase coagulation time.

3. A controller is required to permit step feeding of alum with the number of low lift pumps in operation.

   Estimated cost = $1,300

4. Alum is used in sufficient quantities to justify a liquid alum system. Liquid alum is already used at the Dresden Sewage Treatment Plant, so it can be supplied at the same time that the STP is supplied. Problems with undissolved alum in solution would be eliminated. A liquid alum system would require an alum storage tank (a 13 000L (3,000 Igal) tank should be adequate), a day tank with a mixer and water supply for diluting the alum. The storage tank could be in the room adjacent

to the low lift pump room. A containment area would need to be constructed for the liquid alum storage tank.

Estimated cost = $30,000

Coagulant Aid

Floc formed in the flocculator is a light, fragile floc.

Sodium silicate is not a coagulant aid until part of its alkalinity is neutralized by an acid, and it becomes "activated". Sufficient acid, such as sodium bicarbonate, must be added to neutralize 80 to 90 per cent of the alkalinity.

Recommendation:

Short Term

1. Check alkalinity of sodium silicate to ensure 80 to 90 per cent of its alkalinity is neutralized.

2. The coagulant aid should be moved to the current alum addition point to mix with coagulated water prior to flocculation.

Long Term

1. Use of various polyelectrolytes should be investigated to see if a stronger, denser floc can be produced. A stronger, more settleable floc produced by use of a polymer would reduce the amount of floc carry-over to the filters, thus increasing filter runs.

Lime

Lime is used in the winter, apparently to improve floc settling. However, plant data shows no apparent rise in pH after lime addition. The added lime is probably undissolved in the cold water. Continuous addition of lime into cold

water has resulted in plugging of the clarifier blowdown line and may cause scaling in the new blowdown piping.

Recommendation:

Short Term

1. Discontinue use of lime in winter.

Long Term

1. If necessary, clay (e.g., bentonite or montmorillenite) could be used, if required, to provide weighing of floc.

Potassium Permanganate

PAC was added by staff to remove organic chemicals in the raw water. PAC also removes taste, odour and colour. Since PAC is being used, the need for using potassium permanganate for taste, odour and colour control is questioned.

Recommendation:

Long Term

1. Evaluate the need for continued use of potassium permanganate for taste, odour and colour control by conducting comparative tests on odour intensity of raw water using PAC and potassium permanganate.

F:2 FLOCCULATION

The drive system for the flocculator is outdated and parts cannot be obtained for repair. The drive has not been calibrated so that there is no correlation between the velocity gradient and the speed setting. Neither the desired velocity gradient nor retention time can be attained in the flocculation tank.

Recommendations:

Short Term

1. Conduct test to determine optimum speed setting on flocculator drive. Determine by varying flocculator drive speed setting over the full range and observing the clarifier effluent clarity. Perform test at beginning of every season.

F:3 SEDIMENTATION

The settling tubes are old and fragile, and tend to break off during operation, thus clogging the tubes.

Recommendation:

Short Term

1. Replace settler tubes. During replacement of settler tubes, check wood supports to ensure that they have not rotted. Any scale deposits in clarifier blowdown piping should be removed.

   Estimated cost = $15,000

F:4 FILTERS

The flow to the filters is intermittent. The intermittent flow causes through filters to fluctuate. This can lead to turbidity breakthrough.

An additional problem with the existing system is that the clean filter takes most of the flow. Depending on the operator's schedule, often one filter is cleaned in the morning and the other is not backwashed until late afternoon. Thus, it is possible for one filter to be loaded beyond capacity.

Mudball formations have been found in the filters. These occur due to inefficient cleaning of the filters.

Recommendations:

Short Term

1. Surface wash taken from the backwash header does not provide sufficient pressure for a good surface cleaning. A poor surface wash can lead to mudball formation. Surface washwater should be taken from the WTP service water line.

2. The hydraulically actuated rotary valve should be adjusted to permit the Clayton control valve to modulate to maintain a constant pump well level. This would allow the pump to carry flow to the filters at a more constant flow rate, instead of ON/OFF with the level in the well.

3. There is no back-up pump for the clarifier effluent pump. Should this pump fail, the plant would be inoperative. A back-up pump is required.

   Estimated cost = $15,000

4. Presently, no contingency is available to provide emergency backwash. As a short-term measure, piping and valving should be provided to provide emergency backwash from the water storage tank.

5. An air release valve should be installed in the backwash pump discharge pipe to exhaust air in the pump column.

   Estimated cost = $1,000

6. Gauges should be installed on the filters to monitor head loss. This would allow operators to determine when filters need to be backwashed.

   Estimated cost = $1,500

7. Consideration should be given to replacement of the existing anthracite media with granular activated carbon (GAC), or using the secondary clarifiers as GAC contactors. As a filter media, GAC will provide the added benefit of taste and odour control and organics removal. PAC use could be discontinued, except during the pesticide run-off season, which would reduce operating costs and remove an unsafe system. It is estimated that GAC media would cost approximately $12,000, or approximately $11/day, based on a three-year service life. Based on average PAC usage in 1988, PAC cost approximately $80/day, not including manpower and electrical costs.

8. After backwashing, the initial water filtered after filter start-up should be wasted. The initial water filtered tends to remove particles not backwashed and thus will be higher in turbidity.

<u>Long Term</u>

1. Filter media should be sampled regularly to determine media grain size. Media size may have changed due to washout of fines, attrition, accumulation of precipitates on the media, etc. During the annual clean-out of the filters, media should be sampled to ensure it is properly graded.

F:5 INSTRUMENTATION

Currently, both the raw and treated water flowmeters are out of service. There is no measurement of backwash water usage, nor service water usage. In addition, the flow proportion meter used for flow pacing chemical addition has never been replaced.

There is no method of measuring high or low chlorine residual in the treated water when the plant is unmanned. Even when the plant is manned, monitoring chlorine residuals is dependent on the operator's schedule.

The sensor in the chlorine gas detector is a once use item. After a chlorine leak, the detector must be rebuilt or replaced.

There is no low lift pump failure alarm. A low level at the solids contact clarifier is the earliest process alarm. The problem must be traced from the clarifier back to the low lift pump.

Recommendations:

<u>Short Term</u>

1. Flowmeters are required to measure raw, treated and backwash water flow. Staff report that flowmeters have been ordered. These meters should be installed immediately.

2. As required by MOE, a chlorine residual analyzer with recorder and high and low chlorine residual alarm must be installed. This analyzer would still be used when the Lambton-North Kent supply is constructed since

"top-up" chlorination would still be required at the water storage tank.

Estimated cost of chlorine residual analyzer = $20,000

3. If a chlorine leak occurs, the chlorine gas detector would be destroyed. If this happens, the detector should be replaced with a detector which can be installed outside the Chlorine Room. Gas should be piped from the room to the detector and back into the room. Staff report that a remote chlorine gas detector is on order.

Estimated cost of remote chlorine gas detector = $4,000

4. A low lift pump failure alarm should be installed. Plant staff report that this is on order.

F:6 PROCESS CONTROL

Process control is based on operator experience. Changes in chemical dosing are only made when there is a marked change in raw water quality or when treated water quality deteriorates.

Recommendations:

Long Term

1. Evaluate the use of a streaming current monitor or similar process to control alum dosages.

2. Provide additional laboratory equipment to facilitate testing:

   - glassware
   - pH meter.

F:7 NON-PROCESS CONCERNS

Low Lift Pump Station:

Recommendations:

Short Term

1. Ventilation in the pump station is poor. In the summer, the pump station becomes very hot and, unless windows and doors are left open and the fan turned on, the pumps overheat and stop. Having doors and windows open could lead to vandalism. A proper ventilation system should be installed in the pump station.

   Estimated cost = $35,000

2. The drain in the pump station washdown area is clogged. When screens require cleaning they have to be carried outside. The drain should be rodded. Plant staff report that the floor drain empties into the low lift pump well. This should be verified and if this is the case, the drain should be connected to the sanitary sewer.

Long Term

1. There is no drain for floor washdown. An attempt is made by operators to sweep floor washdown outside; however, much of the washwater, which may contain oils from the pump, ends up in the wet well. Concrete curbs should be constructed around the wet well opening to prevent wastewater from entering.

Mercury-filled switches

Levels sensors in:

- clarifier
- clarifier effluent clearwell

- filter inlet channel

all use mercury-filled switches and Flygt floats.

Low range voltage switches on the pump controllers are mercury-filled.

Recommendation:

<u>Short Term</u>

1. Mercury-filled switches are not appropriate in a water treatment plant. All should be replaced with more suitable devices.

<u>Water Treatment Plant Heating System</u>

The heating system in the main level of the WTP incor-porates Quartz ray infra-red tubes. Installation of these tubes is difficult and the tubes are fragile, and tend to break easily. Tubes are expensive, approximately $80-90 each.

Recommendation:

<u>Long Term</u>

1. The heating system is old (part of the original WTP) and antiquated. It should be replaced with unit heaters.

<u>Conveyor System</u>

The conveyor system used to transport bagged chemicals to the second floor is been broken down. Presently, staff must carry bagged chemicals upstairs.

Recommendation:

<u>Long Term</u>

1. The conveyor system should be repaired to facilitate the transportation of chemicals.

2. Alternately, consideration should be given to relocating chemical storage and mixing on the main floor. With the discontinuation of use of dry alum and lime, the Infilco feeders can be removed. Since use of potassium permanganate can also be discontinued, only the activated silica system would have to be moved to the main floor. By locating this system at the present location of the Infilco feeders:

   - the sodium silicate does not need to be pumped upstairs,

   - sodium bicarbonate can be stored and mixed on the main floor,

   - activated silica can be added to raw water at the present alum addition point.

Sampling

Timing of sampling of raw and treated water is at the convenience of the operator. No attempt is made to capture the same block of water.

Recommendation:

Short Term

1. Operators should sample raw water first. Settled and treated water should be sampled after intervals which allow for retention time in each process.

Operating Manual

Operation of the WTP is labour intensive and depends largely on operator experience with the plant processes.

Recommendations:

Short Term

1. To facilitate plant operation, especially for new operating staff, an operating manual should be prepared. The MOE reports that a consultant is preparing a generic operating manual.

K. Sakamoto, P.Eng.
Project Manager

Aug 3/90.

Lianna Mah

Lianna Mah, P.Eng.
Project Engineer

APPENDIX I

TERMS OF REFERENCE

Appendix A-1

Terms of Reference
Water Plant Optimization Study

Notes:

1. These Terms of Reference should be read in conjunction with The Optimization Protocol (06/04/87 (Rev.1)).

2. References to Appendices and Tables in the Terms of Reference relate those found in the Optimization Protocol.

Purpose

To review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes.

Work Tasks

1. Receive an information package from the MOE. Review the information provided and meet with the MOE staff, if required, to discuss the project.

2. Document the quality and quantity of raw and treated waters.

3. Define the present treatment processes and operating procedures. Prepare a progress report on Works Tasks 1-3 for the Project Committee.

4. Assess the methods of efficient particulate removal which would utilize the present major capital works of the plant. Evaluate the particulate removal efficiency and sensitivity of operation, assuming optimum performance of the plant.

5. Assess current disinfection practices and possible improvement methods.

6. Describe possible short and long-term process modifications to obtain optimum disinfection and contaminant removal.

7. Prepare a draft report for the project committee's review.

8. Prepare the final report.

1. RECEIVE AN INFORMATION PACKAGE FROM THE MOE. REVIEW THE INFORMATION PROVIDED AND MEET WITH THE MOE STAFF, IF REQUIRED TO DISCUSS THE PROJECT.

Elements of Work

(a) Receive an information package from the MOE concerning the plant and the study. This package includes a general terms of reference, a general table of contents for organizing the study in a manner consistent with other plant reports, the WPOS reporting tables and a copy of Ontario Drinking Water Objectives

(b) Review the information and prepare for a meeting to initiate the work on the project, including preparation of a schedule of manpower and staff committments.

(c) Meet with the MOE to discuss the available data, the terms of reference, and the project staff and work schedule. If a consultant is carrying out more that one study it may not be necessary to meet with the MOE at the start of each study.

2. DOCUMENT THE QUALITY AND QUANTITY OF RAW AND TREATED WATERS.

Elements of Work

(a) Prepare a monthly summary of maximum, minimum, and average flows for the last three consecutive years (Table 1.0). Address any discrepancies which exist between raw and treated flow rates.

(b) Based on the above, briefly review and tabulate for the last three years, the monthly maximum, minimum, and average per capita flow for the total population served by the plant (Table 1.1). Compare the plant data with typical per capita flows for the local region. Indicate major consumers who may influence the figures.

(c) Document the methods of measuring the raw and treated water flow rates.

(d) Summarize, for the last three consecutive years, where available, the raw and treated water; turbidity, colour, residual aluminum, iron, pH, temperature and treatment chemical dosages (other than disinfection and fluoridation). The summary should indicate the monthly daily average and maximum and minimum day (Table 2.0).

For the same three year period, tabulate also the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with particulate removal occurred (Tables 2). Document enough data to define and evaluate those problems.

Record other data, such as particulate counting, suspended solids, and algae counting (Table 5.0) which could reflect on particulate removal efficiency.

Document the source and methods used in determining all information.

A comparison should be made between the plant and outside laboratory information to ascertain the relative validity of the data. For plant data, emphasis should be given to plant laboratory tests rather than continuous process control instruments.

(e) Summarize for the last three consecutive years, where available, the disinfectant demand, dosages (including all disinfection related chemicals and residuals) for all application points as well as fluoridation dosage and residual. The summary should indicate the monthly daily average and maximum and minimum day (Table 3.0).

For the same three year period, tabulate (Tables 3) the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with chlorine residuals and/or positive bacterial tests identified in Table 6. Document enough data to define and evaluate those problems.

Document the methods of dosage evaluation and residual measurements, and establish the validity of the data provided.

(f) Prepare a summary, based on at least three years of data, of the raw and treated water quality testing data for physical, microbiological, radiological, and chemical water quality information (Table 4). Document as much data as is needed to show possible seasonal trends in water quality. Where possible, show corresponding sets of raw and treated water quality information.

Document the source and methods used in determining all water quality information and establish the validity of the data, comparing plant and outside laboratory data.

(g) Tabulate, for the last three consecutive years, the raw and treated water bacterial test information at the plant (Table 6).

Document the source and methods used for all data provided.

(h) Document the water sampling systems (source, pump, line-material and size, vertical rise velocity sampling location) used in the plant (similar to DWSP Questionnaire in Appendix A).

(i) Prepare a summary of in-plant testing including Test, Sampling Point, Testing Frequency, Reporting Frequency, Testing Instrumentation including calibration.

(j) Identify other water quality concerns, not related to particulate removal or disinfection, which should be considered as part of the assessment phase of this evaluation program.

3. DEFINE THE PRESENT TREATMENT PROCESSES AND OPERATING PROCEDURES. PREPARE A PROGRESS REPORT ON WORK TASKS 1-3 (8 COPIES), FOR THE PROJECT COMMITTEE.

Elements of Work

(a) Where drawings are available, assemble sufficient record drawings of a reduced size, to document the general site layout and the interrelationship of major plant components. If available, include a process and piping diagram (P&PD) of the plant operations.

(b) Prepare a simplified block schematic of all major plant components including chemical systems and indicating design parameters. Appendix B is an example of the required standard schematic.

(c) Prepare a photographic record of the plant facilities, illustrating all of the major plant components and chemical feed systems. The record should include approximately 30-40 coloured (9 cm x 12 cm) (or 10 cm x 15 cm) prints, suitably labelled. The progress and draft reports may include photocopies in lieu of the prints.

(d) Tabulate the design parameters for all the major plant components, with emphasis on the process operations, including chemical feeds. This information, as a minimum, must be consistent with the CWSP Questionnaire (Appendix A) and must be confirmed and verified by field observations. The design parameters should be evaluated at design, rated and actual operational flows.

(e) Prepare a summary of how the plant is operated, including chemical dosage control, such as jar testing information, filter backwashing procedures and initiation, and pumping and flow control.

(f) Document all reported and other apparent problems in plant operations and/or in the distribution system related to water quality. In addition list the health related parameters which exceed the Ontario Drinking Water Objectives (Table 7).

(g) Submit 8 copies of the progress report to the Prime Consultant for distribution to the Project Committee.

4. ASSESS THE METHODS OF EFFICIENT PARTICULATE REMOVAL WHICH WOULD UTILIZE THE PRESENT MAJOR CAPITAL WORKS OF THE PLANT. EVALUATE THE PARTICULATE REMOVAL EFFICIENCY AND SENSITIVITY OF OPERATION, ASSUMING OPTIMUM PERFORMANCE OF THE PLANT.

Elements of Work

(a) Assess the validity and implication of all information relating to particulate removal provided in Work Tasks 1 and 2 with emphasis on method, metering and sampling, etc.

(b) Using information provided in Work Tasks 1, 2 and 3 evaluate the plant's particulate removal efficiency. The basis of minimum particulate removal should be 1.0 F.t.u. It should, however, be recognized that it is desirable to strive for an operational level which is as low as is achievable.

(c) Conduct an evaluation of possible optimum performance alternatives. Include jar testing using established industry practice.

(d) Evaluate the feasibility of optimum removal using the existing plant capital works. This evaluation should consider the worst case water quality conditions, even though field testing data may not be available during the initial phase of the study (see Work Task 7).

(e) Describe the operational procedures, management strategies, and equipment required for various feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation of the alternatives.

6. ASSESS CURRENT DISINFECTION PRACTICES AND POSSIBLE IMPROVEMENT METHODS.

Elements of Work

(a) Assess the validity and implication of all information relating to disinfection provided in Work Tasks 1, 2 and 3 with emphasis on method, metering and sampling etc.

(b) Using the information provided in Work Tasks 1, 2 and 3 evaluate the plant's ability to disinfect the water. The basis of minimum disinfection should be to ensure a water quality as described in the Ontario Drinking Water Objectives.

(c) Conduct an evaluation of possible optimum disinfection procedures for the plant, with consideration also given to the reduction of chlorinated by-products in the treated water.

(d) Evaluate the feasibility of the various alternatives using the existing plant capital works.

(e) Assess the relative merits of the alternatives. Describe the operational procedures, management strategies, and equipment required for the feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation for the alternatives.

6. DESCRIBE POSSIBLE SHORT AND LONG-TERM PROCESS MODIFICATIONS TO OBTAIN OPTIMUM DISINFECTION AND CONTAMINANT REMOVAL.

Elements of Work

(a) Prepare a list of modifications which should be considered for detailed implementation evaluation. Provide an estimated cost and possible schedule for implementation for each of the proposed modifications.

It is not the purpose of this study to provide a detailed implementation scheme for plant rehabilitation. It is, however, necessary to scope the feasible short and long-term process modifications required to achieve optimum disinfection and contaminant removals.

(b) Incorporate (a) above in the draft report.

7. PREPARE A DRAFT REPORT FOR THE PROJECT COMMITTEE'S REVIEW. (3 COPIES).

Elements of Work

(a) The report must include all information for Work Tasks 1-6.

The information must be organized and presented in a logical and co-ordinated fashion. A general table of contents (Appendix D) is provided for organizing the material in a manner consistent with other plant reports.

Submit the draft report for review by the Project Committee.

(b) Meet with the Project Committee on site at least one week after submission of the report.

(c) Prepare a separate letter report containing recommendation's concerning the need for additional field testing to cover quality conditions not available during the period of this study. The Project Committee may decide to delay completion of the final report until field data can be obtained to confirm the predictions of performance for the worst case water conditions.

APPENDIX II

TYPICAL
UTILITY MONITORING
INFORMATION SYSTEM

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B1

WATER TREATMENT PLANT

UTILITY MONITORING SYSTEM

B1

Municipality :DRESDEN
Project Name :DRESDEN WTP
Project Number :6-0007-57-00
Project Location :DRESDEN, ONT
Works/org Numbers:210000283 5550
Superintendent/Chief Operator:CHUCK SHERMAN

Month/Year DECEMBER 1989

Enter comments on the bottom of this page.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL /MGR	AVG	MAX	MIN
FLOWS																																				
RAW WATER	1000 m3 D																									11.30	14.40	19.35	14.24	13.47	21.06		93.8			
PLANT EFFL (TREATED OUT)	1000 m³ D																																- -			
MAX HR RATE	1000m3/d D																																- -			-
RAW WATER (CHEMICAL)																																				
HARDNESS	mg/l																																	-		
ALKALINITY	mg/l																																	-		
IRON	mg/l																																	-		
CHLORIDE	mg/l																																	-		
pH	*	8.3	8.4	8.5	7.9	7.9	8	7.9	8	8	8	7.9	7.9	8	8	7.9	8	7.9	7.8	8	7.8	7.9	7.8	7.8	7.6	7.6	7.7	7.9	7.6	7.6	7.8	7.6		7.9		
CONDUCTIVITY	umhos/cm																																	-		
FLUORIDE	mg/l																																	-		
TOTAL P.	mg/l																																	-		
DISSOLVED P.	mg/l																																	-		
NH4	mg/l																																	-		
TKN	mg/l																																	-		
NITRITE	mg/l					0.1							0.03								0.03													0.053		
NITRATE	mg/l					11.8							9.6								7.6													9.667		
CHLOROPHYLL A	ug/l																																	-		
CHLOROPHYLL B	ug/l																																	-		
RAW WATER (PHYSICAL)																																				
TURBIDITY	Ftu	*216.0	219.0	200.0	68.0	34.0	37.0	29.0	[illegible]	20.0	16.0	17.0	13.0	12.0	16.0	18.0	16.0	21.0	10.0	12.0	13.1	10.0	9.0	10.0	8.0	8.0	8.0	7.8	7.4	7.4	7.8	7.9		35.6	*****	
COLOUR	Hazen u					34.5							14								11													19.8	34.5	
TEMPERATURE	°C *D	2.0	2.5	2.0	2.0	2.0	3.0	3.0	3.0	3.0	5.0	2.0	1.5	2.0	3.0	1.5	1.0	1.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	2.0	3.0	2.0	2.0	2.0	3.0	2.0		2.4		
ALGAE	(Tot Asu/ml)																																	-		

*RECORD FLOW ACTUALLY LEAVING PLANT

11 May-90
MOE SWP 11/88 LOTUS VER 50.12
09:05 AM

Ministry
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Ontario

82

WATER TREATMENT PLANT

UTILITY MONITORING SYSTEM

82

Municipality :DRESDEN
Project Name :DRESDEN WTP
Project Number :6-0007-57-00 Month/Year DECEMBER 1989
Project Location :DRESDEN, ONT
Works/org Numbers:210000282 5550
Superintendant/Chief Operator:CHUCK SHERMAN

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		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL /MBR	AVG	MAX	MIN
DISINFECTION																																				
PRE CL2 USED	kg D																																			
PRE CL2 DOSAGE	mg/l																																	-		
AVG PRE CL2 RES	mg/l *																																	-		
SODIUM HYPO	kg D																																			
POST CL2 USED	kg D	4.54	4.53	4.08	5.89	8.16	9.98	8.62	4.99	4.54	3.17	4.99	1.81	2.26	5.44	4.98	4.08	3.63	7.6	4.536	5.9	5.44	5.44	5.9	5.9	6.35	5.44	5.44	3.63	3.18	3.63	2.72	156.6			
POST CL2 DOSAGE	mg/l	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR		ERR		
AVG CL2 RESID	mg/l *	1	1	1.06	1	1.25	1.25	1.3	1.3	1.2	1.2	1.3	1.35	1.05	1.35	1.45	1.1	1.35	1.2	1.3	1.5	1.5	1.5	1.5	1.3	1.65	1.4	1.5	1.4	1.5	1.5	1.3		1.31		
MAX CL2 RESID	mg/l	1	1	1.2	1	1.3	1.3	1.5	1.3	1.2	1.2	1.3	1.4	1.1	1.5	1.5	1.2	1.5	1.2	1.3	1.45	1.45	1.5	1.5	1.4	1.7	1.5	1.5	1.5	1.5	1.5	1.6			1.70	
MIN CL2 RESID	mg/l	1	1	1	1	1.2	1.2	1.1	1.3	1.2	1.2	1.3	1.3	1	1.2	1.4	1	1.2	1.2	1.3	1.4	1.5	1.5	1.5	1.2	1.6	1.2	1.5	1.2	1.5	1.5	1				1.00
RAW WATER (BACTERIOLOGICAL) Indicate # of samples in each class																																				
TOTAL	0-100/100ml																																			
COLI-	101-5000/100ml												1								1												2			
FORMS	>5000/100ml					1																											1			
FECAL	0-10/100ml																																			
COLI-	11-500/100ml					1							1								1												3			
FORMS	>500/100ml																																			
FECAL	0-1/100ml																																			
STREPTO-	2-50/100ml																				1												1			
COCCI	>50/100ml					1							1																				2			
TREATED WATER (BACTERIOLOGICAL) Indicate # of samples in each class																																				
TOTAL	present																																			
COLI-	* absent					1							1								1												3			
FORMS	* 1-4/100ml																																			
	>4/100ml																																			
FECAL	present																																			
COLIFORMS	* absent					1							1								1												3			
FECAL	present																																			
STREP	* absent					1							1								1												3			
STANDARD	0-500/ml					1							1								1												3			
PLATE COUNT	>500/ml																																			

* Samples with results of L2, L4, or ZERO should be entered in the absent row.

11-May-90
MOE SWR 11/88 LOTUS VER 50.12
09:05 AM

Ministry
of the
Environment
Ontario

B3

WATER TREATMENT PLANT

UTILITY MONITORING SYSTEM

B3

Municipality :DRESDEN
Project Name :DRESDEN WTP
Project Number :6-0007-57-00
Project Location :DRESDEN, ONT
Works/org Numbers:210000283 5550
Superintendent/Chief Operator:CHUCK SHERMAN

Month/Year: DECEMBER 1989

Enter comments on the bottom of this page.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL /MSR	AVG	MAX	MIN
DISTRIBUTION SYSTEM (BACTERIOLOGICAL)	Indicate # of samples in each class																																			
TOTAL COLI-FORMS	present												1																				1			
	# absent					3							3								3												9			
	# 1-4/100ml																																			
	>4/100ml																																			
FECAL COLIFORMS	present																																			
	# absent					3							4								3												10			
FECAL STREP	present																																			
	# absent					3							4								3												10			
# Samples with results of L2, L4, or ZERO should be entered in the absent row.																																				
STANDARD PLATE COUNT	0-500/ml					3							4								3												10			
	>500/ml																																			
TREATED WATER (CHEMICAL)																																				
HARDNESS	mg/l																																	-		
ALKALINITY	mg/l																																	-		
IRON	mg/l																																	-		
CHLORIDE	mg/l																																	-		
pH	#*		7.5	7.2	7.3	7.1	7.3	7.6	8	7.5	7.5	7.3	7.4	7.4	7.5	7.4	7.4	7.3	7.6	7.5	7.5	7.6	7.5	7.6	7.5	7.4	7.4	7.5	7.8	7.5	7.7	7.6		7.2		
CONDUCTIVITY	umhos/cm																																- -	-	-	-
FLUORIDE	mg/l #																																	-		
DISSOLVED P	mg/l																																	-		
NH4	mg/l																																	-		
TKN	mg/l																																			
NITRITE	mg/l					0.001							0.001								0.01													0.004		
NITRATE	mg/l					11.8							9.9								9.0													******		
ALUMINUM	mg/l #																																- -	-		
TREATED WATER (PHYSICAL)																																				
AVG TURBIDITY	Ftu #	0.86	0.46	0.46	0.40	0.60	0.25	0.61	0.50	0.48	0.60	0.39	0.48	0.62	0.55	0.81	0.41	0.54	0.43	0.37	0.30	0.60	0.24	0.41	0.67	0.38	0.42	0.38	0.31	0.44	0.33	0.12	AVG OV	0.47	0.86	
# SAMPLES	>1.0 Ftu																																			
MAX TURBIDITY	Ftu	0.88	0.59	0.54	0.40	0.89	0.43	0.71	0.50	0.40	0.55	0.53	1.22	0.68	0.55	1.40	0.63	0.58	0.43	0.52	0.33	0.76	0.27	0.78	0.90	0.46	0.55	0.38	0.42	0.48	0.46	0.15	FAILS MOE		C1.40	
AVG COLOUR	Hazen u					7							4.5								4												FAILS	5.2		
# SAMPLES >5	Hazen u					1																											1			
MAX COLOUR	Hazen u					7							4.5								4												FAILS		7.0	
TEMPERATURE	°C D	2	2.5	2	2	2	3	3	3	3	5	2	1.5	3	3	1.5	1	1	3	3	3	3	2	2	3	2	3	2	2	2	3	2		2.4	5.0	

11-May-90
MOE SWR 11/86 LOTUS VER 50.12
03:05 AM

Ministry
of the
Environment
Ontario

84-C4

WATER TREATMENT PLANT
or WELL

UTILITY MONITORING SYSTEM

Municipality :DRESDEN
Project Name :DRESDEN WTP
Project Number :6-0007-57-00 Month/Year DECEMBER 1989
Project Location :DRESDEN, ONT
Works/org Numbers:210000283 5550
Superintendent/Chief Operator:CHUCK SHERMAN

Enter comments on the bottom of this page.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL /MER	AVG	MAX	M
PROCESS CHEMICALS																																				
ALUM (LIQUID)	m3 D																																			
ALUM (SOLID)	kg D	45.4	45.4	90.8	113.5	90.8	181.6	90.8	68.1	45.4	68.1	45.4	68.1	68.1	68.1	68.1	22.7	45.4	90.8	68.1	45.4	90.8	68.1	68.1	45.4	90.8	68.1	68.1	68.1	68.1	45.4	45.4	2156.5			
ALUM DOSAGE	mg/l																																			
SODIUM SILICATE	kg D	34	30	19	36	38	41	51	42	13	33	53	28	25	14	28	28	22	19	27	29	36	15	41	31	41	28	32	15	17	22	16	904.0			
SOD SIL DOSAGE	mg/l	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR		ERR		
SODIUM BICARB	kg D	29.3	25.85	16.37	31.02	32.74	35.33	43.95	36.19	11.2	29.44	45.67	24.13	21.54	12.06	24.13	24.13	18.96	16.37	23.27	24.99	31.03	12.93	35.34	26.72	35.33	24.13	27.58	12.93	14.65	18.96	13.78	780.0			
SOD BICARB DOS	mg/l	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR		ERR		
* POLYMER	kg D																																			
POLYMER DOSAGE	mg/l																																	-		
ACT CARBON	kg D																																			
ACT CARB DOSAGE	mg/l																																	-		
FLUORIDE CHEMICALS																																				
H2SiF6 <-: as F	kg D																																			
Na2SiF6 : as F	kg D																																			
NaF : as F	kg D																																			
F DOSAGE <-:	mg/l																																	-		
LIME	kg																											68.1	22.7	45.4	45.4	45.4	227.0			
LIME DOSAGE	mg/l																											ERR	ERR	ERR	ERR	ERR		ERR		
SODA ASH	kg																																			
SODA ASH DOSAGE	mg/l																																	-		
POTASSIUM PERM	kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5												9.0			
POT PERM DOSAGE	mg/l	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR		ERR													ERR		
AMMONIA	kg																																			
AMMONIA DOSAGE	mg/l																																	-		
SULPHUR DIOXIDE	kg																																			
SUL DIOX DOSAGE	mg/l																																	-		
AMMONIUM SULPH.	kg																																			
AM SULPH DOSAGE	mg/l																																	-		
SODIUM HYDROXIDE	kg																																			
SOD HYD DOSAGE	mg/l																																	-		
CORROSION INHIB.	kg																																			
COR INH DOSAGE	mg/l																																	-		
FLUORIDE CHEMICALS																																				
H2SiF6 gross wt	kg																																			
Na2SiF6 gross wt	kg																																			
NaF gross wt	kg																																			

* POLYMERS USED > _______________ _______________ _______________

11-May-90
MOE SWR 11/88 LOTUS VER 50.12
09:05 AM

Ministry
of the
Environment
Ontario

85-C5

WATER TREATMENT PLANT
or WELL

UTILITY MONITORING SYSTEM

85-C5

Municipality :DRESDEN
Project Name :DRESDEN WTP
Project Number :6-0007-57-00
Month/Year DECEMBER 1989
Project Location :DRESDEN, ONT
Works/org Numbers:210000280 5550
Superintendant/Chief Operator:CHUCK SHERMAN

Enter comments on the bottom of this page.

FILTRATION		TYPE OF FILTER: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
No OF FILTERS IN USE		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
INF TURBIDITY	Ftu	38.00	27.00	24.00	26.00	29.60	13.00	10.10	10.30	10.60	5.80	4.90	5.60	6.40	5.50	8.90	4.00
EFF TURBIDITY	Ftu	0.86	0.46	0.46	0.40	0.60	0.25	0.61	0.50	0.48	0.60	0.39	0.48	0.62	0.55	0.81	0.41
AVG FILTER RUN	Hrs	12.0	12.0	12.0	12.0	8.0	12.0	12.0	12.0	24.0	24.0	12.0	24.0	24.0	24.0	24.0	24.0

FILTRATION		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL /MBR	AVG	MAX	MI
No OF FILTERS IN USE		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2		
INF TURBIDITY	Ftu	6.00	4.30	5.40	6.60	6.10	10.40	10.60	35.60	4.60	6.90	4.80	4.70	4.30	3.30	4.70		11.2		
EFF TURBIDITY	Ftu	0.59	0.43	0.37	0.30	0.60	0.24	0.41	0.67	0.38	0.42	0.38	0.31	0.44	0.33	0.12		0.5		
AVG FILTER RUN	Hrs	24.0	24.0	24.0	24.0	12.0	12.0	12.0	24.0	12.0	24.0	24.0	24.0	24.0	24.0	24.0		18.8		

FILTER BACKWASH		AVG
VOLUME	1000 m3 D	
% OF TREATED FLOW		-
BOD	mg/l	-
SS	mg/l	-
TOT P	mg/l	-
TKN	mg/l	-

CLARIFIER SLUDGE		AVG
VOLUME	m3 D	-
BOD	mg/l	-
SS	mg/l	-
TOT P	mg/l	-
TKN	mg/l	-

PLANT FLOW BALANCE
Final out % of Raw
In Plant % of Raw
Backwash % of Raw

COMMENTS:

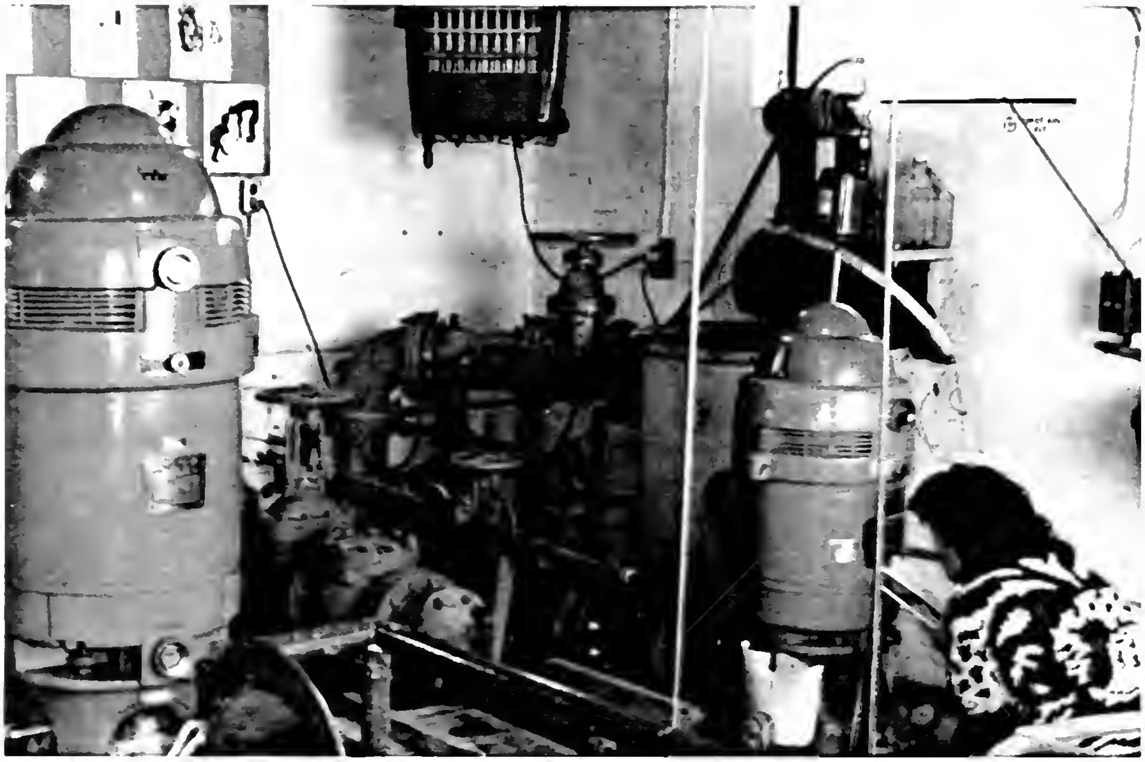
11-May-90
MOE SWP 11/88 LOTUS VER 50.12

APPENDIX III

PHOTOGRAPHS

Sydenham River at Treatment Plant Intake

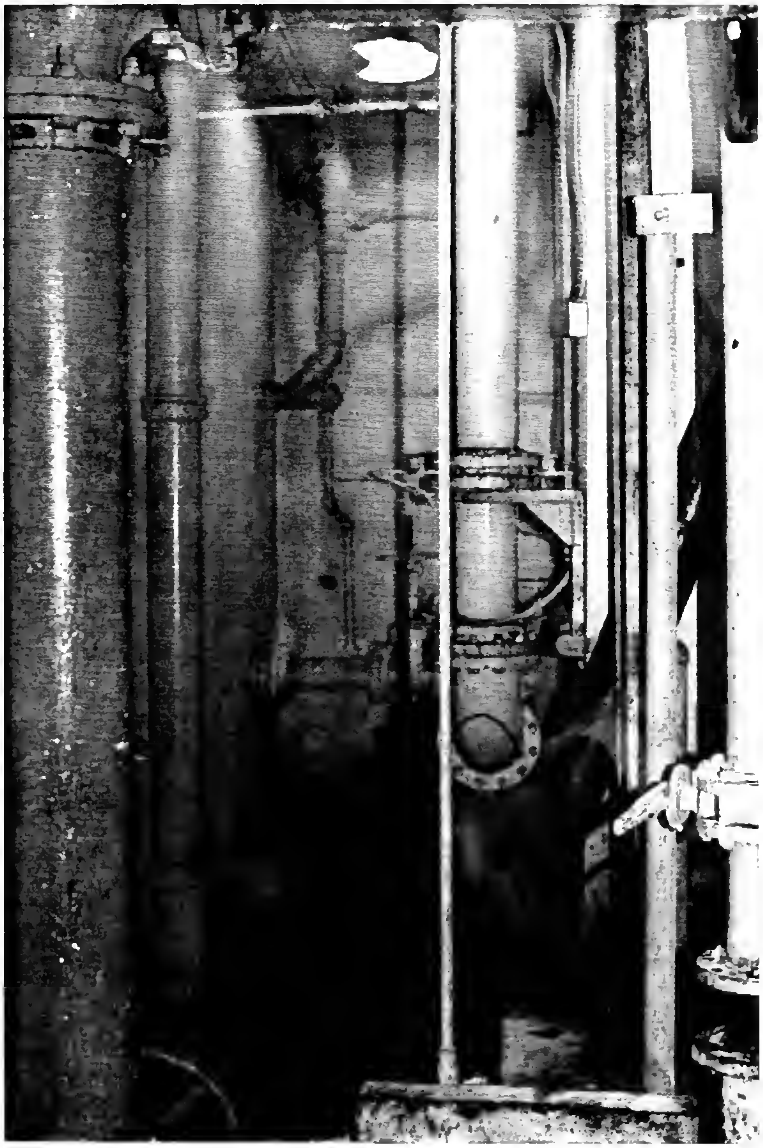
Low Lift Pump Station
NOTE: Shaft of low lift pump 2 was removed.
Pump and shaft were replaced June 1989.



Low Lift Pumps
Town pump on right. Nabisco pump on left.
NOTE: One of Town pumps was removed for replacement.
The PAC day tank is behind the Town pump.

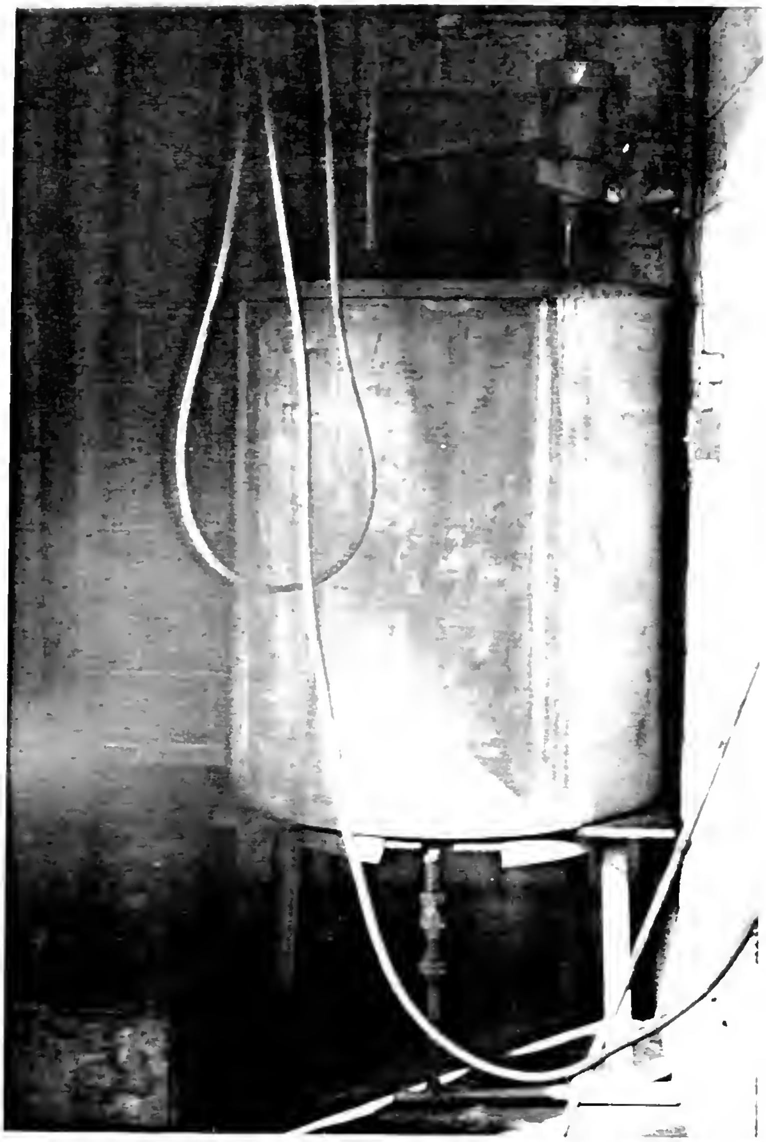
Raw Water Sampling
Cables connect raw water screens to
winch & pulley system (background).

Dresden Treatment Plant Building
(Looking East)



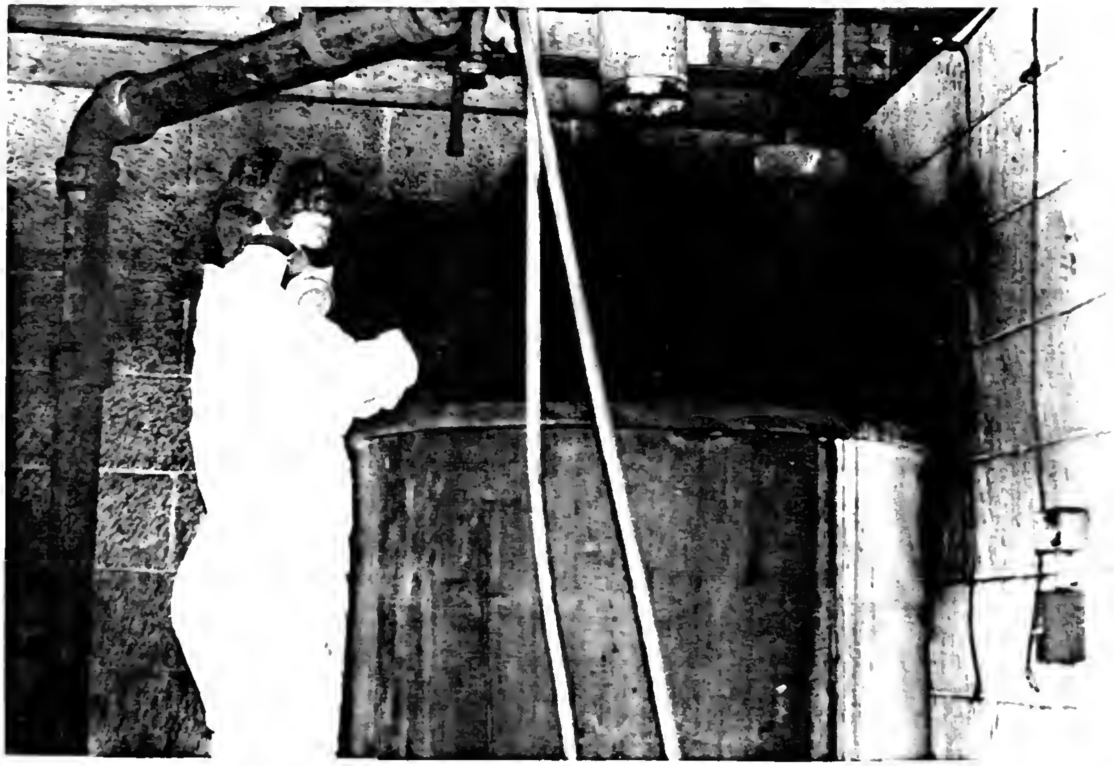
Pipe Gallery

BLUE: Raw Water
BROWN: Sanitary
GREY: Treated Water



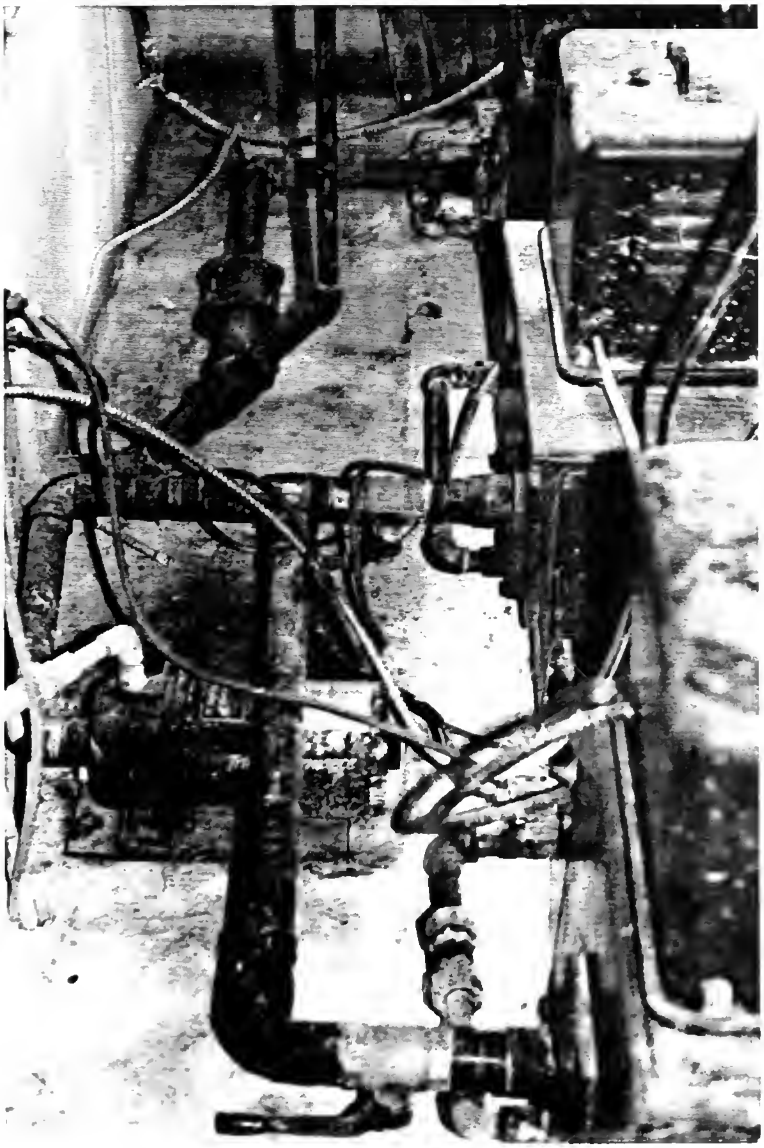
PAC Storage & Make-up Area

Located behind Low Lift Pump Station



R. LaLiberte Preparing PAC Solution

Alum Feeder & Stand-by Alum Feeder (Right)
Lime Feeder: far right, out of picture



Alum Solution

Alum Feed Pump (Foreground)
Lime Gravity Feed
(Background)

Sodium Silicate Drums and Pump
(To Activated Silica Make-up Area)

Activated Silica
Make-up Tanks

Potassium Permanganate Solution Make-up / Day Tank (Foreground)

Sodium Bicarbonate Make-up Tank (Background)

Laboratory and Office

Solids-Contact Clarifier:

Drive Unit (Bottom Left)

Flocculator (Bottom Centre)

Sedimentation (Annular Ring)

Clarifier Sludge Blow-Down To Sump

Settling Tubes in
Sedimentation
Tank

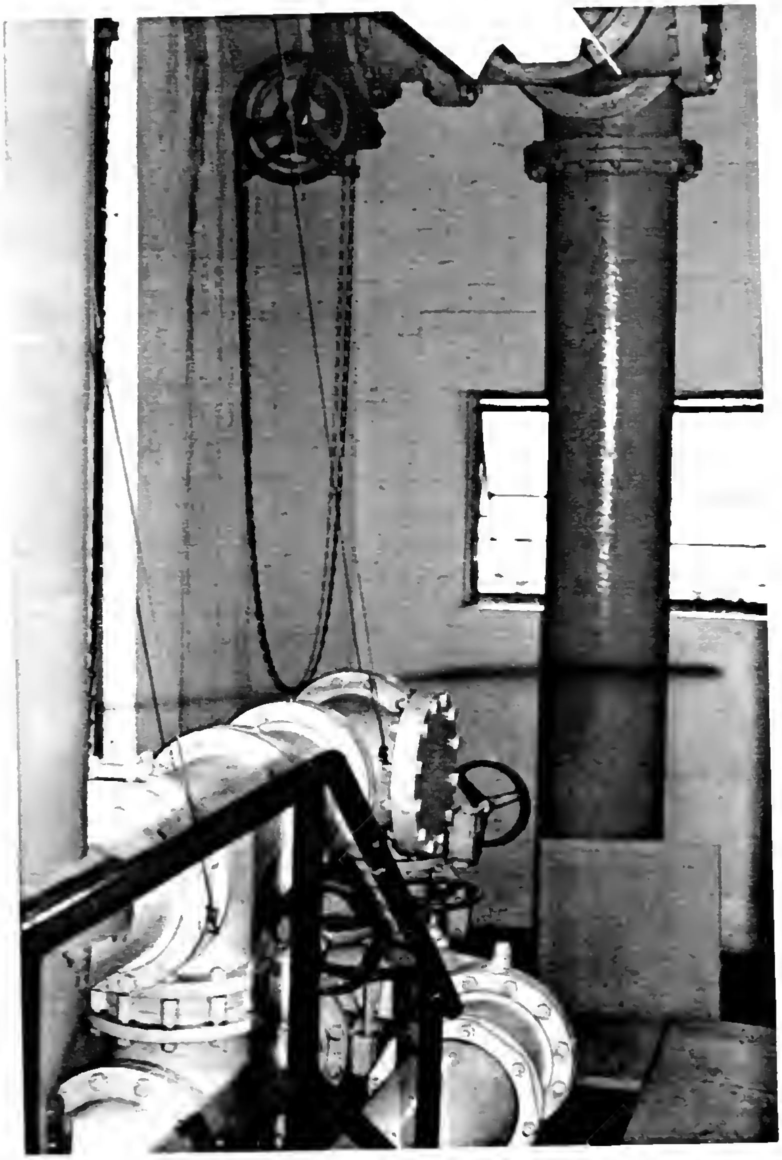
High Lift & Fire Pumps (Left)
Backwash Pump (Right-Background)
Clarifier Effluent Pump (Right Foreground)

Filter Area

Filter Backwash

Piping & Valves (Grey)

Sanitary Piping (Brown)



APPENDIX IV

TABLES

DRESDEN WATER TREATMENT PLANT

TABLE 1.0: FLOWS (ML/d)

MONTH	R/T (2)	1989 (1)			1988			1987		
		MAX.	MIN.	AVG.	MAX.	MIN.	AVG	MAX.	MIN.	AVG.
JAN	R									
	T	4.113	3.21	3.818	4.136	2.322	3.168	2.977	2.025	2.718
FEB	R									
	T	4.287	3.548	4.037	3.752	2.334	3.459	3.574	1.942	2.903
MAR	R									
	T	4.746	3.387	4.169	2.940	0.885	1.997	3.278	1.892	2.850
APR	R									
	T	4.560	1.89	3.065	3.701	1.586	3.035	3.600	2.489	2.955
MAY	R									
	T				3.959	3.003	3.393	3.753	2.033	2.964
JUN	R									
	T				4.249	3.125	3.624	3.351	2.298	2.724
JUL	R									
	T				4.117	1.928	3.415	3.411	1.761	2.405
AUG	R									
	T				3.471	0.867	2.075	3.382	1.270	2.463
SEP	R									
	T				3.364	1.122	2.946	3.925	2.079	2.974
OCT	R									
	T				3.882	2.207	3.325	3.470	1.683	2.797
NOV	R									
	T				3.721	2.105	2.681	3.604	1.963	2.953
DEC	R									
	T				4.200	3.188	3.752	3.520	1.345	2.650

NOTES: 1. Flow recorder broken (May - Dec. 1989)
2. R=Raw T=Treated Drinking Water

SOURCE: WTP Utility Monitoring Records, Sheet B1

TABLE 1.1: PER CAPITA CONSUMPTION

CONSUMPTION	1989 (3)	1988	1987
Population (1)	2568	2568	2568
Maximum Day (L/C/D)	1,848	1,655	1,528
Minimum Day (L/C/D)	736	338	495
Average Day (L/C/D)	1,469	1,196	1,082
Ratio MD:AD (2)	1.26	1.38	1.41

NOTES:
1. Estimated population served (Township Clerk).
2. Ratio of maximum day to average day treated water flows from Table 1.0.
3. 1989: Based on flow data available

TABLE 2.0: PARTICULATE REMOVAL SUMMARY

MONTH	PARAMETER		1989			1988			1987		
			MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
JAN	Turbidity (FTU)	R	732.0	13.0	105.9	88.0	6.5	27.8	100.0	10.0	28.3
		T	0.47	0.12	0.25	0.80	0.15	0.38	0.69	0.28	0.43
	Colour (TCU)	R	170.0	0.5	57.0	70.0	6.0	28.3	68.0	14.0	24.0
		T	8.0	1.0	5.5	9.5	0.2	4.6	4.0	1.0	2.5
	Prime Coagulant	(mg/L)	50.4	5.5	29.5	71.7	13.1	41.5	95.9	30.9	45.4
	Sodium Silicate	(mg/L)	9.8	1.8	6.0	70.6	5.1	9.9	14.6	3.1	7.0
	Sodium Bicarbonate	(mg/L)	8.4	1.8	5.2	6.7	1.6	4.0	12.5	2.5	6.0
	PAC	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lime	(mg/L)	25.0	3.9	8.7	15.4	8.7	11.5	15.7	15.7	15.7
	Pot'm Permanganate	(mg/L)	0.3	0.2	0.3	0.4	0.2	0.3	0.3	0.3	0.3
	pH	R	8.1	6.9	7.8	8.3	7.3	7.7	8.3	7.7	8.0
		T	8.2	6.8	7.4	8.2	7.0	7.5	8.1	7.2	7.8
	Temperature (DEG.C)	R	2.0	0.5	1.3	4.0	0.5	1.7	4.0	1.0	1.8
FEB	Turbidity (FTU)	R	153.0	6.0	21.6	90.0	12.0	40.5	35.0	6.0	15.0
		T	0.36	0.12	0.23	0.95	0.20	0.36	0.86	0.25	0.48
	Colour (TCU)	R	40.0	12.0	23.4	81.0	19.5	42.3	29.0	5.0	13.0
		T	70.0	3.0	4.7	7.5	2.5	4.6	3.5	1.0	1.8
	Prime Coagulant	(mg/L)	71.0	5.3	13.6	91.0	19.9	47.5	85.2	20.0	50.7
	Sodium Silicate	(mg/L)	7.5	2.2	4.3	14.7	2.1	7.7	12.9	4.4	7.2
	Sodium Bicarbonate	(mg/L)	6.5	2.9	3.7	12.6	1.8	6.5	10.2	3.3	6.0
	PAC	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lime	(mg/L)	2.1	1.3	1.5	8.2	5.1	5.6	69.3	6.2	21.4
	Pot'm Permanganate	(mg/L)	0.3	0.1	0.2	0.4	0.3	0.3	0.5	0.3	0.4
	pH	R	8.2	7.9	8.0	8.3	7.4	7.6	8.2	7.8	7.9
		T	8.3	7.2	7.8	7.9	7.0	7.2	8.0	7.1	7.6
	Temperature (DEG.C)	R	2.0	0.5	1.2	2.5	1.0	1.4	2.0	1.0	1.5

NOTE: R=Raw T=Treated Drinking Water

SOURCE WTP Utility Monitoring Records

TABLE 2.0: (cont'd)

MONTH	PARAMETER		1989			1988			1987		
			MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
MAR	Turbidity (FTU)	R	344.0	10.0	68.0	270.0	11.0	80.5	250.0	17.0	57.0
		T	0.41	0.14	0.28	0.95	0.13	0.41	9.60	0.19	0.70
	Colour (TCU)	R	31.0	16.0	22.3	53.5	21.0	44.3	100.0	14.0	30.9
		T	16.0	6.0	10.8	11.5	2.5	5.8	4.0	2.0	2.8
	Prime Coagulant	(mg/L)	35.0	5.1	13.2	149.6	23.1	68.1	210.3	53.9	87.0
	Sodium Silicate	(mg/L)	8.8	2.5	4.2	103.0	3.4	15.9	22.1	5.1	11.7
	Sodium Bicarbonate	(mg/L)	5.9	2.1	3.7	22.2	3.0	11.0	19.0	4.4	10.1
	PAC	(mg/L)	6.7	4.8	5.5	16.9	4.6	8.6	0.0	0.0	0.0
	Lime	(mg/L)	18.3	4.8	6.2	95.4	11.8	36.2	8.6	8.6	8.6
	Pot'm Permanganate	(mg/L)	0.3	0.2	0.2	1.4	0.3	0.5	0.6	0.6	0.6
	pH	R	8.1	7.8	7.9	8.2	6.7	7.8	8.4	7.5	7.9
		T	8.3	7.8	8.1	8.4	7.0	7.7	8.1	6.7	7.4
	Temperature (DEG.C)	R	11.0	0.5	2.8	7.0	1.0	2.9	12.0	1.0	4.9
APR	Turbidity (FTU)	R	145.0	26.0	61.8	174.0	25.0	58.5	140.0	16.0	49.0
		T	0.63	0.10	0.23	1.20	0.08	0.17	0.59	0.22	0.33
	Colour (TCU)	R	3.1	16.0	21.0	46.0	13.0	26.5	156.0	14.0	55.8
		T	8.5	3.0	5.0	4.5	2.5	3.5	4.5	1.0	2.7
	Prime Coagulant	(mg/L)	63.9	5.2	15.9	138.7	19.7	39.7	71.2	29.5	42.1
	Sodium Silicate	(mg/L)	9.0	2.4	5.8	11.8	1.4	6.7	15.3	3.1	6.5
	Sodium Bicarbonate	(mg/L)	7.8	2.1	5.0	10.1	1.2	6.0	13.1	2.7	5.6
	PAC	(mg/L)	21.4	5.3	15.6	15.8	6.8	8.4	0.0	0.0	0.0
	Lime	(mg/L)	9.5	1.1	3.3	4.4	2.7	3.2	0.0	0.0	0.0
	Pot'm Permanganate	(mg/L)	1.1	0.4	0.7	0.4	0.3	0.3	0.2	0.2	0.2
	pH	R	8.5	7.5	8.1	8.3	8.0	8.1	8.2	7.7	8.0
		T	8.4	7.4	7.9	7.6	7.1	7.4	7.9	7.1	7.5
	Temperature (DEG.C)	R	13.0	4.5	8.3	13.0	8.0	10.0	18.0	3.5	10.7

NOTE: R=Raw T=Treated Drinking Water

SOURCE: WTP Utility Monitoring Records

TABLE 2 0: (cont'd)

MONTH	PARAMETER		* 1989			1988			1987		
			MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
MAY	Turbidity (FTU)	R	90.0	27.0	47.8	110.0	38.0	55.8	60.0	22.0	37.0
		T	0.59	0.24	0.37	0.36	0.10	0.20	0.62	0.23	0.36
	Colour (TCU)	R	27.0	15.0	18.1	28.0	20.0	24.0	35.0	10.0	21.5
		T	9.5	5.5	5.9	2.0	5.0	3.8	4.5	1.0	2.5
	Prime Coagulant	(mg/L)				61.3	21.4	35.0	48.3	41.2	43.9
	Sodium Silicate	(mg/L)				11.4	3.6	6.1	14.7	4.3	7.5
	Sodium Bicarbonate	(mg/L)				7.9	3.1	4.3	12.7	3.7	6.5
	PAC	(mg/L)				39.6	21.6	33.8	0.0	0.0	0.0
	Lime	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Pot'm Permanganate	(mg/L)				0.3	0.3	0.3	0.3	0.3	0.3
	pH	R	8.2	7.9	8.1	8.3	7.7	8.0	8.2	7.7	7.9
		T	* 8.1	7.4	7.8	7.5	7.1	7.3	7.5	7.3	7.4
	Temperature (DEG.C)	R	21.5	12.0	15.6	22.0	11.0	16.8	24 0	13.0	17.8
JUN	Turbidity (FTU)	R	260.0	49.0	90.6	54.0	20.0	34 5	260.0	14.0	76.0
		T	0.55	0.22	0.32	0.60	0.16	0.32	0.62	0.23	0.40
	Colour (TCU)	R				22.0	17.5	19.0	60.0	20.0	44.0
		T	9.5	4.5	6.5	4.5	3.0	3.6	8.0	1.0	3.2
	Prime Coagulant	(mg/L)				50.8	12.1	35.1	91.9	49.5	64.5
	Sodium Silicate	(mg/L)				9.5	1.0	5.0	11.8	5.1	9.1
	Sodium Bicarbonate	(mg/L)				8 4	0.8	4.3	11.1	4.4	7 8
	PAC	(mg/L)				38.8	20.3	31.8	0.0	0.0	0.0
	Lime	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Pot'm Permanganate	(mg/L)				0.3	0.2	0 3	0.6	0.6	0.6
	pH	R	8.0	7.3	7.9	8.1	7.8	7.9	7.9	7.3	7.6
		T	7.6	7.3	7.5	7.5	7.2	7.3	7.3	6 9	7.0
	Temperature (DEG.C)	R	24.5	18.0	20.4	25.0	19.0	22.2	35.0	20.0	23.1

NOTE R=Raw T=Treated Drinking Water

* Flow meter inoperative Where not indicated, dosages are not available

SOURCE WTP Utility Monitoring Records

TABLE 2.0. (cont'd)

MONTH	PARAMETER		* 1989 MAX	MIN	AVG	1988 MAX	MIN	AVG	1987 MAX	MIN	AVG
JUL	Turbidity (FTU)	R	105.0	34.0	66.4	93.0	17.0	39.5	55.0	16.0	30.0
		T	0.84	0.40	0.52	0.56	0.18	0.40	0.44	0 24	0.31
	Colour (TCU)	R	30 5	18.0	22.8	70.0	8.0	36.9	42.0	16.0	23.5
		T	7.0	5 0	6.0	17.0	1.0	6.4	5.0	1.0	2.7
	Prime Coagulant	(mg/L)				92.6	11.5	32.2	62.9	62.9	62.9
	Sodium Silicate	(mg/L)				12.8	2.8	6.1	16.1	3.0	8.5
	Sodium Bicarbonate	(mg/L)				7.8	2.4	4.6	13.9	2.5	7.3
	PAC	(mg/L)				51.0	18.8	26.6	44.0	8.0	16.5
	Lime	(mg/L)	0.0	0 0	0.0	0 0	0 0	0.0	0.0	0.0	0.0
	Pot'm Permanganate	(mg/L)				0.5	0 2	0.2	0.6	0.6	0.6
	pH	R	8.0	7.8	7.9	8.1	7.5	7.8	7.9	7.5	7 7
		T	7 6	7.4	7.5	7.5	6.9	7.3	7.3	6.7	7.1
	Temperature (DEG C)	R	28.0	21.5	24 1	29.0	22.0	25.7	28.0	23.0	25.7
AUG	Turbidity (FTU)	R	168.0	31.0	61.7	72.0	15 2	41.0	55.0	16 0	34 0
		T	0.87	0.37	0.71	0.84	0 22	0.36	0.43	0.26	0.34
	Colour (TCU)	R	22.0	20.0	20 9	45.0	14 5	27.4	28.0	9.0	19.3
		T	8.0	5.0	6.6	6.0	1.0	3.5	3.5	1.0	2.3
	Prime Coagulant	(mg/L)				497 0	13.2	101.5	94.9	62.6	71 2
	Sodium Silicate	(mg/L)				16.9	3.9	9.6	16.4	5.0	10 6
	Sodium Bicarbonate	(mg/L)				14.6	3.4	8.3	14.2	4.3	9 2
	PAC	(mg/L)				59.1	13.4	37.3	0.0	0 0	0.0
	Lime	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0
	Pot'm Permanganate	(mg/L)				1.1	0.3	0.6	0.5	0.5	0.5
	pH	R	8.7	7.8	8 0	8.1	7.6	7.9	7.9	7.4	7 7
		T	7.6	7.4	7.5	7.4	6.8	7.1	7.3	6.9	7.1
	Temperature (DEG.C)	R	26.0	21.0	22.8	29.0	21.0	25.2	27.0	18.0	23 4

NOTE R=Raw T=Treated Drinking Water

* Flow meter inoperative Where not indicated, dosages are not available

SOURCE WTP Utility Monitoring Records

TABLE 2.0: (cont'd)

MONTH	PARAMETER			* 1989			1988			1987	
			MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
SEP	Turbidity (FTU)	R	150.0	25.0	81.2	40.0	16.0	27.5	58.0	0.3	38.0
		T	1.00	0.18	0.50	0.43	0.18	0.29	0.40	0.22	0.31
	Colour (TCU)	R	22.5	18.0	20.3	50.0	12.0	22.3	48.0	16.0	25.3
		T	5.5	3.5	4.8	9.0	2.0	5.0	6.5	1.0	2.9
	Prime Coagulant	(mg/L)				60.6	17.7	33.7	71.6	44.1	54.5
	Sodium Silicate	(mg/L)				11.6	3.0	6.5	11.8	5.8	8.2
	Sodium Bicarbonate	(mg/L)				10.0	2.6	5.6	10.2	5.0	7.0
	PAC	(mg/L)				37.3	29.7	35.3	0.0	0.0	0.0
	Lime	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Pot'm Permanganate	(mg/L)				0.4	0.3	0.4	0.4	0.4	0.4
	pH	R	8.2	7.8	7.9	8.3	7.8	8.0	8.0	7.6	7.8
		T	7.6	7.2	7.4	7.6	7.1	7.4	7.5	7.0	7.2
	Temperature (DEG.C)	R	23.0	12.0	19.0	22.0	17.0	19.1	21.5	17.0	19.4
OCT	Turbidity (FTU)	R	200.0	24.0	86.6	66.0	13.0	29.5	125.0	23.0	48.0
		T	1.10	0.19	0.47	0.63	0.13	0.24	0.49	0.24	0.35
	Colour (TCU)	R	30.5	19.0	22.8	66.0	6.0	26.7	102.0	5.0	34.8
		T	5.5	3.0	4.0	7.5	1.0	30.8	8.0	1.0	3.0
	Prime Coagulant	(mg/L)				82.0	12.0	31.0	54.4	37.9	48.7
	Sodium Silicate	(mg/L)				13.1	1.3	5.1	13.0	2.4	7.0
	Sodium Bicarbonate	(mg/L)				11.3	1.4	4.4	11.2	2.1	6.1
	PAC	(mg/L)				24.9	6.4	13.2	0.0	0.0	0.0
	Lime	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Pot'm Permanganate	(mg/L)				0.5	0.3	0.3	0.7	0.7	0.67
	pH	R	8.2	7.5	7.9	8.1	7.8	8.0	8.0	7.3	7.8
		T	8.2	7.2	7.6	7.7	7.1	7.3			
	Temperature (DEG.C)	R	14.0	8.0	11.6	18.0	5.0	10.9	17.0	7.0	11.0

NOTE. R=Raw T=Treated Drinking Water

* Flow meter inoperative Where not indicated, dosages are not available

SOURCE WTP Utility Monitoring Records

TABLE 2.0: (cont'd)

MONTH	PARAMETER		* 1989			1988			1987		
			MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
NOV	Turbidity (FTU)	R	474.0	22.0	106.7	520.0	12.0	115.8	295.0	14.0	58.0
		T	1.70	0.24	0.56	0.61	0.10	0.23	0.58	0.19	0 32
	Colour (TCU)	R	74.0	20.0	42.9	210.0	30.0	77.4	70.0	2.0	27.9
		T	11.0	5.5	7.3	16.0	1.0	7.8	8.0	1 0	2.8
	Prime Coagulant	(mg/L)				116.6	18.9	61.1	98.0	37 0	47 4
	Sodium Silicate	(mg/L)				16 2	3 4	8.2	16.1	4.1	7 6
	Sodium Bicarbonate	(mg/L)				15.3	3.2	7.2	23.9	3.6	6.9
	PAC	(mg/L)				25.1	9.0	18.8	0.0	0.0	0.0
	Lime	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	29.9	13.0	21.0
	Pot'm Permanganate	(mg/L)				0.5	0.3	0.4	1.0	1.0	1.0
	pH	R	8.4	7.8	8.0	8.2	7.3	7.9	8.2	7.5	7.9
		T	8.0	7.3	7.6	7.4	6.9	7.1	7.6	6.8	7.3
	Temperature (DEG C)	R	13.0	2.0	6.3	9.0	6.0	6.8	12.0	2.0	7.2
DEC	Turbidity (FTU)	R	219.0	7.4	35.6	200.0	6.3	27.8	340.0	25.0	117.0
		T	0.86	0.12	0.47	0.56	0.10	0.25	0.82	0.25	0.46
	Colour (TCU)	R	34.5	11.0	19.8	67.0	5.0	19.0	112.0	26.5	71 0
		T	7.0	4.0	5.2	12.0	1.0	4.8	6.0	5.5	5.6
	Prime Coagulant	(mg/L)				49.6	10.1	17.4	115.0	22.2	71.9
	Sodium Silicate	(mg/L)				7.7	1.8	4.3	29.5	5 2	14.3
	Sodium Bicarbonate	(mg/L)				6.6	1.5	3.8	25.4	4 5	12.3
	PAC	(mg/L)	0.0	0.0	0.0	28.0	11.2	21.0	0.0	0.0	0.0
	Lime	(mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	6.3	2.4	4.7
	Pot'm Permanganate	(mg/L)				0.3	0.2	0.3	0.7	0 7	0.7
	pH	R	8.5	7.6	7.9	8.3	7.6	8.1	8.1	6.9	7.6
		T	8.0	7.1	7.2	7.8	6.8	7.6	7 8	6.9	7.2
	Temperature (DEG.C)	R	5.0	1.0	7 4	6.0	0.5	1.7	7.0	1.5	4.2

NOTE R=Raw T=Treated Drinking Water

* Flow meter inoperative Where not indicated, dosages are not available

SOURCE WTP Utility Monitoring Records

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (JAN. 1989)

DATE	TURBIDITY (FTU) Raw	Set	Filter	Treat	COLOUR (TCU) Raw	Treat	COAGULANT (ALUM) mg/L	COAG AID (1) mg/L	(2) mg/L	PAC mg/L	LIME mg/L	KMnO4 mg/L	METAL RES. Al (mg/L) Raw	Treat.	pH Raw	Treat	TEMP (DEG C)
1	51.0	10.2		0.31	25.0		46.41	3.3	2.9	0.0	40.0	0.3			7.6	6.9	0.5
2	40.0	10.6		0.21			24.61	4.3	3.7	0.0	40.0	0.3			7.7	6.8	2.0
3	35.0	8.8		0.22	45.0	4.5	48.67	4.8	4.2	0.0	40.0	0.3			7.7	7.1	1.5
4	21.0	6.8		0.29			36.68	2.4	2.1	0.0	20.0	0.3			7.6	7.0	2.0
5	17.0	7.5		0.38	31.0	2.0	18.07	7.4	6.4	0.0	20.0	0.3			7.9	7.3	2.0
6	15.0	4.6		1.90			18.48	4.6	4.0	0.0	40.0	0.3			7.8	8.2	1.0
7	13.0	2.6		0.25			5.55	5.1	4.4	0.0	80.0	0.2			8.0	7.7	2.0
8	732.0	19.8		0.38			22.64	6.2	5.4	0.0	100.0	0.2			8.0	–	2.0
9	33.0	23.3		0.26	49.0	4.5	50.28	6.2	5.3	0.0	50.0	0.2			7.9	7.3	2.0
10	350.0	16.2		0.21	170.0	3.0	50.35	6.7	5.7	0.0	50.0	0.2			7.9	7.2	0.5
11	264.0	17.4		0.30	70.0	10.0	49.62	5.8	5.0	0.0	40.0	0.2			6.9	7.0	
12	198.0	21.0		0.18	56.0	1.0	33.51	7.6	6.6	0.0	20.0	0.2			7.8	7.6	0.2
13	143.0	19.0		0.24			36.85	7.3	6.3	0.0	20.0	0.3			7.8	7.2	1.0
14	103.0	11.9		0.21			32.64	6.0	6.2	0.0	40.0	0.3			7.9	7.4	2.0
15	57.0	9.2		1.60			36.36	6.1	5.3	0.0	40.0	0.3			7.8	7.3	2.0
16	43.0	14.3		0.27	35.0	8.0	23.36	4.4	3.8	0.0	40.0	0.3			7.8	7.4	0.5
17	34.0	6.1		0.17	33.5	5.5	23.01	4.8	4.2	0.0	20.0	0.3			7.9	7.5	0.5
18	31.0	11.4		0.28	37.0	10.0	41.25	3.9	3.4	0.0	20.0	0.3			7.8	7.5	0.5
19	28.0	8.9		0.47			18.27	4.0	3.5	0.0	20.0	0.3			7.9	7.4	0.5
20	28.0	11.8		0.22			20.72	2.2	1.9	0.0	25.0	0.3			7.8	7.4	0.5
21	24.0	10.2		0.27			19.79	1.8	1.8	0.0	25.0	0.3			7.9	7.3	1.0
22	24.0	11.2		0.25	42.0		28.25	9.3	8.1	0.0	32.0	0.3			8.0	7.4	1.2
23	21.0	7.7		0.25			19.08	9.8	8.4	0.0	32.0	0.3			8.1	7.7	1.5
24	22.0	4.4		0.15		4.5	12.37	8.2	7.0	0.0	20.0	0.3			8.0	8.1	2.0
25	13.0	3.6		0.12	36.0		12.33	6.8	5.9	0.0	25.0	0.3			8.0	7.9	2.0
26	22.0	4.5		0.18			28.12	8.4	7.3	0.0	20.0	0.2			8.1	8.0	1.5
27	119.0	18.3		0.37	80.0		29.68	8.4	7.2	0.0	15.0	0.3			7.8	7.4	1.5
28	126.0	11.6		0.25	76.0		35.01	8.2	7.1	0.0	20.0	0.3			7.9	7.3	2.0
29	96.0	12.3		0.21	55.0		35.50	8.6	7.4	0.0	30.0	0.3			7.8	7.3	2.0
30	83.0	19.0		0.28			27.93	6.2	6.3	0.0	30.0	0.2			7.6	7.4	1.0
31	200.0	8.7		0.32	72.0	7.5	29.62	6.8	5.9	0.0	20.0	0.3			7.8	7.3	1.5

NOTE (1) Sodium Silicate dosage

(2) Sodium Bicarbonate dosage

Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (APRIL 1989)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES. Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set	Filter	Treat	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat	Raw	Treat	
1	93.0	9.2		0.22	20.0		26.60	8.2	7.9	17.6	2.0	0.8			7.9	7.8	6.0
2	47.0	8.3		0.18		4.0	9.70	6.8	5.9	19.2	2.1	0.9			8.4	8.1	6.0
3	108.0	6.9		0.22	31.0		12.33	5.4	4.7	12.2	1.4	0.5			8.0	8.0	6.0
4	143.0	12.6		0.33	28.0		10.43	9.0	7.7	10.3	1.1	0.5			7.6	8.0	9.0
5	145.0	14.7		0.22		3.0	23.52	7.8	6.7	11.7	1.3	0.5			7.8	8.0	10.0
6	100.0	13.0		0.26	22.0		21.01	7.4	6.4	5.3	1.2	0.5			8.0	8.0	9.0
7	102.0	16.0		0.24	19.0		29.17	3.9	3.3	11.6	1.3	0.5			7.5	8.0	8.0
8	54.0	2.2		0.10		4.5	63.94	8.5	7.3	21.0	2.3	0.9			8.1	7.5	6.0
9	50.0	2.1		0.11			31.82	8.4	7.2	21.0	2.3	0.9			8.0	7.4	6.0
10	64.0	3.3		0.27	17.0		16.56	5.1	4.4	10.9	4.9	0.5			8.0	7.5	5.0
11	34.0	3.0		0.10	23.5	5.0	14.93	2.4	2.1	9.9	4.4	0.4			8.2	7.5	4.5
12	28.0	2.4		0.11	20.0		16.52	4.9	4.2	10.9	4.9	0.5			8.2	8.0	5.5
13	71.0	11.5		0.17			5.19	4.0	3.4	11.2	5.0	0.5			8.0	8.2	4.5
14	78.0	6.7		0.25	18.0		5.88	3.9	3.3	11.7	5.2	0.5			8.2	8.2	5.0
15	68.0	4.8		0.20	16.0		21.51	5.7	4.9	21.3	9.5	0.9			8.2	8.0	6.5
16	57.0	5.8		0.22			7.85	4.2	3.6	15.6	0.0	0.7			8.1	7.6	8.0
17	63.0	6.6		0.20	22.0		8.53	4.5	3.9	16.9	0.0	0.8			8.1	8.3	10.0
18	89.0	4.8		0.17			19.31	3.8	3.3	19.1	0.0	0.9			8.0	7.8	9.0
19	86.0	3.9		0.63		8.5	9.30	6.6	5.7	18.4	0.0	0.8			8.0	7.7	8.0
20	52.0	3.1		0.19			7.30	4.5	3.9	14.5	0.0	0.6			8.1	7.6	9.0
21	44.0	2.8		0.17	20.0	5.5	7.88	4.5	3.9	15.6	0.0	0.7			8.1	7.8	9.5
22	35.0	3.6		0.26			10.80	6.7	5.7	21.4	0.0	1.0			8.2	7.8	10.0
23	36.0	3.1		0.15			24.02	9.0	7.8	23.8	0.0	1.1			8.2	7.9	8.0
24	32.0	0.6		0.28			8.57	6.0	5.2	17.0	0.0	0.8			8.2	8.2	10.0
25	34.0	2.6		0.21			7.85	6.9	6.0	15.6	0.0	0.7			8.2	8.4	12.0
26	30.0	2.3		0.28	17.0	5.0	12.33	4.9	4.2	12.2	0.0	0.5			8.5	7.8	12.0
27	31.0	3.2		0.25			7.32	5.0	4.7	14.5	0.0	0.6			8.4	7.9	13.0
28	27.0	2.8		0.26			15.18	5.0	4.3	15.1	0.0	0.7			8.4	8.1	12.5
29	26.0	3.6		0.30			10.55	6.5	5.6	20.9	0.0	0.9			8.4	7.8	11.0
30	26.0	4.0		0.27			10.60	5.6	4.8	21.0	0.0	0.9			8.4	7.8	11.0

NOTE (1) Sodium Silicate dosage
(2) Sodium Bicarbonate dosage
Filter turbidity and metal residual not measured

TABLE 2.1: PARTICULATE REMOVAL PROFILE (JULY 1989)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set	Filter	Treat	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat	Raw	Treat.	
1	87 0	8 5		0.47							0 0				8 0	7 5	21 5
2	81 0	7 0		0.46							0 0				8 0	7 5	22 5
3	94 0	8 1		0.43							0 0				8 0	7 5	24 0
4	42 0	15 7		0 52	22 5	6 5					0 0				8 0	7 5	24 0
5	68 0	7 2		0 52							0 0				8 0	7 5	24 0
6	71 0	5 2		0 56							0 0				7 9	7 5	24 0
7	56 0	5 3		0 56							0 0				7 9	7 5	24 0
8	63 0	8 1		0 62							0 0				7 9	7 5	22 0
9	63 0	5 4		0 58							0 0				7 9	7 5	25 5
10	52 0	5 5		0 56							0 0				7 9	7 5	25 0
11	34 0	5 6		0 44							0 0				8 0	7 6	27 0
12	34 0	7 7		0 45	21.0	7 0					0 0				8 0	7 6	26 0
13	71 0	8 2		0 62			Flow recorder broken,				0 0				7 9	7 5	26 0
14	88 0	8 4		0 56							0 0				8 0	7 5	23 5
15	67 0	7 9		0 59			dosages not available				0 0				7 9	7 5	24 0
16	63 0	6 6		0 53							0 0				8 0	7 5	22 5
17	54 0	6.0		0 42							0 0				7 9	7 5	23 0
18	54 0	6 8		0 46	18.0	5.5					0 0				7 8	7 5	22 5
19	55 0	9 2		0 41							0 0				7 9	7 5	23 0
20	58 0	8 3		0 46							0 0				7 9	7 5	23 0
21	68 0	8 6		0 52							0 0				7 9	7 4	22 0
22	40 0	6 9		0 39							0 0				7 8	7 4	23 0
23	41 0	6 8		0 42							0 0				7 8	7 5	23 5
24	77 0	7 9		0 60							0 0				7 9	7 4	24 5
25	101 0	12 1		0 56							0 0				7 9	7 4	25 0
26	40 0	6 7		0 40	22 0	6 0					0 0				7 8	7 4	27 0
27	65 0	7 7		0 53							0 0				7 9	7 5	28 0
28	105 0	7 4		0 54							0 0				8 0	7 4	25 0
29	95 0	8 4		0 58	30 5	5 0					0 0				8 0	7 4	24 0
30	99 0	12 6		0 64							0 0				8 0	7 5	24 0
31	72 0	7 8		0 84							0 0				8 0	7 6	23 0

NOTE. (1) Sodium Silicate dosage
(2) Sodium Bicarbonate dosage
Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (OCT. 1989)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set	Filter	Treat	Raw	Treat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat	Raw	Treat	
1	60 0	7 7		0 32							0 0				7 5	7 2	14 0
2	98 0	5 0		0 39							0 0				7 8	7 6	14 0
3	91 0	6 4		0 46							0 0				7 9	7 4	13 0
4	79 0	8 7		0 45							0 0				7 8	7 5	13 0
5	72 0	6 2		0 49							0 0				7 8	7 4	13 0
6	75 0	4 9		0 40							0 0				7 9	7 4	13 5
7	50 0	7 6		0 48							0 0				8 0	7 4	12 5
8	38 0	2 2		0 38							0 0				8 2	7 6	12 0
9	41 0	2 8		0 37							0 0				8 1	7 5	11 5
10	24 0	5 2		0 19	19 0	3 0					0 0				8 2	7 5	12 0
11	200 0	4 7		0 42							0 0				8 0	7 3	13 0
12	120 0	4 6		0 38							0 0				8 0	7 5	13 0
13	100 0	5 1		0 44			Flow recorder broken,				0 0				8 1	7 4	12 0
14	94 0	12 1		0 48							0 0				7 8	7 4	13 0
15	58 0	3 5		0 32			dosages not available				0 0				7 6	8 2	14 0
16	55 0	4 0		0 27							0 0				7 8	8 0	12 0
17	77 0	5 5		0 56							0 0				7 9	7 9	12 0
18	143 0	6 0		0 48	19 0	3 5					0 0				7 8	7 8	11 0
19	102 0	8 0		0 48							0 0				8 0	7 7	8 0
20	146 0	7 5		0 63							0 0				7 9	7 5	8 5
21	109 0	10 9		0 53							0 0				7 9	7 4	9 0
22	138 0	10 4		0 65							0 0				7 9	7 4	9 0
23	31 0	14 0		1 10							0 0				7 9	7 4	8 0
24	66 0	16 9		0 77							0 0				8 0	7 9	10 0
25	40 0	9 5		0 40	30 5	5 5					0 0				8 0	7 5	10 0
26	113 0	8 0		0 60							0.0				7 9	7 4	11 5
27	197 0	8 8		0 46							0 0				8 0	7 6	11 0
28	61 0	8 9		0 46							0 0				8 0	7 7	11 5
29	55 0	8 7		0 41							0 0				7 8	7 5	12 0
30	74 0	15 7		0 42							0 0				7 7	7 6	12 0
31	77 0	13 9		0 46							0 0				8 0	7 8	12 0

NOTE: (1) Sodium Silicate dosage
(2) Sodium Bicarbonate dosage
Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (JAN. 1988)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set.	Filter	Treat.	Raw	Treat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	24.0	4.2		0.53			33.62	6.3	5.4	0.0	13.3	0.4			7.5	7.3	2.0
2	15.0	2.5		0.53			23.09	5.8	5.0	0.0	12.2	0.3			8.0	8.0	2.0
3	13.0	1.5		0.32			23.44	6.9	5.9	0.0	12.3	0.3			8.3	7.7	1.0
4	10.0	4.4		0.19			13.09	7.8	6.7	0.0	10.3	0.3			8.1	7.7	1.0
5	13.0	4.8		0.32	17.5		30.77	7.1	6.0	0.0	9.7	0.3			7.4	7.3	1.0
6	7.5	4.7		0.26	10.0	3.5	42.13	7.7	6.7	0.0	11.1	0.3			7.8	7.3	1.0
7	7.1	4.2		0.29	21.0	2.0	38.39	9.7	8.3	0.0	8.7	0.2			7.8	7.3	0.5
8	9.0	3.4		2.70			41.58	5.1	1.0	0.0	13.1	0.4			7.5	7.4	0.5
9	7.0	4.1		0.31			35.13	6.2	1.7	0.0	11.1	0.3			7.8	7.4	1.0
10	7.4	3.3		0.24			50.52	6.3	1.3	0.0	13.2	0.4			7.8	7.5	1.0
11	8.0	6.5		0.32			30.01	6.9	1.6	0.0	9.5	0.3			7.8	7.5	1.0
12	9.0	6.0		0.33	15.5	4.0	38.25	15.1	0.5	0.0	10.0	0.3			7.7	7.5	2.0
13	18.0	2.5		0.28	6.0	2.0	31.59	14.2	3.4	0.0	10.0	0.3			7.3	7.5	2.0
14	23.0	2.8		0.34	9.0	3.0	42.37	9.9	2.6	0.0	11.1	0.3			7.7	7.3	2.0
15	12.0	3.2		0.31			51.40	9.7	6.7	0.0	13.4	0.4			7.7	7.5	2.0
16	8.0	4.6		0.41			58.83	9.6	3.1	0.0	13.3	0.4			7.9	7.5	1.5
17	6.5	1.5		0.38			37.64	5.6	1.6	0.0	11.9	0.3			7.9	7.5	2.0
18	34.0	5.9		0.42			19.13	11.3	2.7	0.0	10.1	0.3			7.9	7.7	4.0
19	67.0	6.9		0.36	16.5	9.5	29.13	14.8	4.1	0.0	11.5	0.3			7.5	7.6	4.0
20	88.0	6.0		0.70	70.0	6.0	39.06	17.2	6.4	0.0	15.4	0.4			7.3	7.5	4.0
21	64.0	8.4		0.53		4.0	50.35	10.1	2.8	0.0	11.3	0.3			7.6	7.6	1.0
22	78.0	21.0		0.50			55.08	11.4	3.4	0.0	12.4	0.3			7.4	7.4	1.0
23	63.0	18.3		0.27			46.27	10.5	3.1	0.0	12.2	0.3			7.7	8.2	3.0
24	43.0	5.0		0.25	70.0	5.0	43.06	10.8	2.9	0.0	11.3	0.3			7.7	7.5	2.0
25	33.0	6.0		0.80		4.0	40.59	10.1	2.6	0.0	10.6	0.3			7.6	7.6	2.0
26	31.0	7.2		0.25	47.0	8.0	57.23	12.0	3.3	0.0	11.3	0.3			7.6	7.6	1.0
27	25.0	4.5		0.29			54.42	6.9	1.8	0.0	10.7	0.3			7.6	7.2	1.0
28	21.0	7.0		0.43			52.91	10.5	2.6	0.0	10.4	0.3			7.6	7.0	2.0
29	20.0	9.0		0.15			48.77	9.4	2.4	0.0	9.6	0.3			7.6	7.4	2.0
30	81.0	5.4		0.50			71.65	13.8	2.9	0.0	14.1	0.4			7.4	7.2	2.0
31	17.0	4.0		0.50			55.69	6.1	2.1	0.0	11.0	0.3			7.6	7.2	1.0

NOTE (1) Sodium Silicate dosage

(2) Sodium Bicarbonate dosage

Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (APRIL 1988)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set.	Filter	Treat	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat	Raw	Treat	
1	50.0	4.0		0.11			138.70	7.0	6.0	10.9	4.4	0.4			8.0	7.4	8.0
2	54.0	3.9		0.13			39.80	1.4	1.2	8.8	3.5	0.4			8.0	7.4	8.5
3	51.0	2.5		0.14			29.78	6.3	4.5	8.2	3.3	0.3			8.0	7.3	10.0
4	74.0	4.1		0.14			35.48	4.7	4.0	7.8	3.1	0.3			8.1	7.4	10.0
5	150.0	5.6		0.17		3.5	40.31	7.1	6.1	7.4	2.9	0.3			8.1	7.3	11.0
6	174.0	4.6		0.18	46.0		53.16	5.9	5.1	7.3	2.9	0.3			8.0	7.3	12.0
7	126.0	5.7		0.11			53.21	5.0	4.3	7.3	2.9	0.3			8.1	7.2	10.0
8	130.0	6.2		1.20			63.20	6.2	5.3	7.7	3.1	0.3			8.1	7.4	9.0
9	95.0	6.9		0.10			35.68	7.6	6.5	7.9	3.1	0.3			7.9	7.2	8.0
10	63.0	7.7		0.13			30.04	6.0	5.1	8.3	3.3	0.3			8.1	7.3	8.0
11	62.0	4.6		0.10	29.0	4.5	24.50	5.4	4.7	6.8	2.7	0.3			8.1	7.4	9.0
12	42.0	4.4		0.10			31.84	5.3	4.5	8.8	3.5	0.4			8.0	7.3	9.0
13	48.0	3.2		0.10		3.5	30.01	5.0	6.0	8.3	3.3	0.3			8.0	7.1	11.0
14	50.0	3.0		0.25			26.06	4.5	5.1	8.1	0.0	0.3			8.0	7.6	11.0
15	49.0	4.0		0.21			37.18	10.1	10.0	15.8	0.0	0.6			8.0	8.1	11.0
16	40.0	3.0		0.24			34.57	5.0	4.3	9.5	0.0	0.4			8.0	7.4	11.0
17	35.0	3.5		0.11			31.50	2.4	6.0	8.7	0.0	0.3			8.0	7.4	9.0
18	36.0	2.3		0.36			39.80	7.7	6.7	8.8	0.0	0.4			8.2	7.4	10.0
19	34.0	2.4		0.11	18.0	2.5	30.60	6.1	5.2	8.4	0.0	0.3			8.1	7.4	10.0
20	40.0	2.5		0.10			30.05	7.3	6.3	8.3	0.0	0.3			8.2	7.5	9.0
21	25.0	2.5		0.12			34.03	8.7	7.5	7.5	0.0	0.3			8.0	7.5	8.0
22	33.0	2.3		0.08			42.92	9.8	8.4	7.9	0.0	0.3			8.2	7.5	9.0
23	40.0	2.2		0.19			39.21	11.8	10.1	8.6	0.0	0.3			8.2	7.6	10.0
24	42.0	1.5		0.03			30.71	8.1	7.0	8.5	0.0	0.3			8.2	7.6	11.0
25	42.0	2.0		0.18	13.0		19.74	9.5	8.2	7.2	0.0	0.3			8.3	7.5	11.0
26	39.0	2.3		0.11			44.76	7.5	6.5	8.2	0.0	0.3			8.2	7.3	11.0
27	40.0	1.6		0.13			28.81	7.3	6.3	7.9	0.0	0.3			8.3	7.5	11.0
28	39.0	1.6		0.10			36.77	1.6	6.4	8.1	0.0	0.3			8.2	7.3	13.0
29	29.0	2.8		0.13			36.20	6.7	5.8	8.0	0.0	0.3			8.2	7.4	11.0
30	32.0	4.0		0.11			21.19	9.6	8.3	7.8	0.0	0.3			8.0	7.5	11.0

NOTE: (1) Sodium Silicate dosage

(2) Sodium Bicarbonate dosage

Filter turbidity and metal residual not measured

TABLE 2.1: PARTICULATE REMOVAL PROFILE (JULY 1988)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set	Filter	Treat	Raw	Treat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat	
1	20 0	1 9		0 34			19 65	6 3	5 4	28.7	0 0	0 3			8 1	7 3	23 0
2	27 0	1 8		0 33			20 75	3 6	3 1	30 3	0 0				7 9	7 4	23 0
3	24 0	2.1		0 31			25 12	8 9	7 6	20 8	0 0	0 3			8 0	7 3	23 0
4	22 0	2 0		0 31	8.0	7.0	36 77	8 6	7 5	20 3	0 0				7 9	7 4	22 0
5	17 4	2 6		0 38	17 5		27 54	6 3	5 4	24 3	0 0	0 2			7 8	7 4	23 0
6	23 0	3 5		0 43		6 0	50 23	8 9	7 6	27 7	0 0				7 9	2 0	29 0
7	29 0	1 8		0 36			35 25	4 7	4 0	23 3	0 0	0 3			7 8	7 3	24 0
8	27 0	2 3		0 46			23 29	4 9	4 2	25 7	0 0				7 8	7.4	25 0
9	30 0	6 7		0 43			25 12	5 3	4 5	27 7	0 0				7 7	7 3	26 0
10	25 0	3 1		0 42			18 54	4 4	3 8	20 4	0 0	0 3			7 8	7 3	27 0
11	33 0	1 6		0 56	15 5	5 5	25 75	9 1	7 8	28 4	0 0				7 8	7 4	26 0
12	17 0	2 7		0 51	8 0	5.2	12 25	3 2	2 8	20 2	0 0	0 3			7 9	7 4	26 0
13	22 0	2 8		0 52			11 83	3 1	2 7	19 6	0 0				7 8	7 4	26 0
14	27 0	2 9		0 56			12 91	4 8	4 2	28 4	0 0	0 3			7 9	7 5	26 0
15	29 0	3 4		0 49			19 14	4 8	4 1	28 1	0 0				7 8	7 5	26 5
16	30 0	2 4		0 46			11 48	3 8	3 3	19 0	0 0	0 3			7 9	7.4	26 5
17	32 0	2 4		0 49			17 92	3 7	3 2	19 8	0 0				7 9	7 3	26 5
18	33 0	2 5		0 41	18 0	6 0	17 06	2 8	2 4	18 8	0 0				7 8	7 4	28 0
19	53 0	2 9		0 53	17 0	6 0	16 93	3 0	2 6	24 9	0 0				7 8	7 4	26 0
20	93 0	8 9		0 51	52 0	1 0	11 64	5 1	4 4	25 7	0 0	0 3			7 9	7.3	25 0
21	83 0	5 7		0 61	70 0	6 0	12 24	6 5	5 6	20 2	0 0	0 3			7 5	7 1	24 0
22	67 0	2 6		0 18	70 0	15 0	50 96	7 6	6 5	21 1	0 0				7 6	7 0	24 5
23	53 0	3 1		0 21	.		42 93	3 7	3 2	21 6	0 0	0 3			7 6	7 0	24 5
24	59 0	3 3		0 22			42 85	4 3	3 7	21 6	0 0				7 6	7 0	25 0
25	74 0	5 7		0 29	70 0	1 0	38 80	5 2	4 5	26 0	0 0	0 3			7 7	6 9	25 0
26	60 0	6 0		0 37	64 0	14 0	76 85	10 2	0 0	33 9	0 0	0 3			7 8	7 0	25 0
27	52 0	4 4		0 29			65 56	10 7	0 0	41 3	0 0	0 4			7 7	7 2	26 0
28	48 0	3 8		0.31			92 55	12 8	0 0	51 0	0 0	0 5			7 8	7 3	26 0
29	45 0	3 8		0 38	33 0	1 0	47 03	6 4	0 0	41 5	0 0				7 8	7 2	26 0
30	38 0	3 3		0 40			58 81	12 1	0 0	38 9	0 0	0 5			7 8	7 1	27 0
31	31 0	1 6		0 44			29 73	4 5	0 0	24 6	0 0				7 7	6 9	26 0

NOTE. (1) Sodium Silicate dosage

(2) Sodium Bicarbonate dosage

Filter turbidity and metal residual not measured

TABLE 2.1: PARTICULATE REMOVAL PROFILE (OCT. 1988)

DATE	TURBIDITY (FTU) Raw	Set	Filter	Treat	COLOUR (TCU) Raw	Treat	COAGULANT (ALUM) mg/L	COAG AID (1) mg/L	COAG AID (2) mg/L	PAC mg/L	LIME mg/L	KMnO4 mg/L	METAL RES Al (mg/L) Raw	Treat.	pH Raw	pH Treat	TEMP (DEG C)
1	31.0	3.9		0.21			71.95	5.4	4.7	24.9	0.0	0.5			7.9	7.3	18.0
2	31.0	3.3		0.20			33.95	10.5	9.0	18.7	0.0	0.4			8.0	7.5	18.0
3	29.0	3.4		0.15	20.0	7.0	19.47	4.0	2.4	14.2	0.0	0.3			7.9	7.1	18.0
4	37.0	2.8		0.17	13.5	3.0	24.18	2.7	2.3	6.7	0.0	0.3			7.8	7.3	17.0
5	31.0	3.0		0.14	22.0	2.0	32.77	3.5	3.0	7.2	0.0	0.3			8.0	7.4	15.0
6	26.0	2.2		0.15	10.0	2.0	31.41	3.6	3.1	13.9	0.0	0.3			7.9	7.2	14.0
7	25.0	2.9		0.18			17.72	3.4	2.9	13.0	0.0	0.3			7.9	7.4	13.0
8	32.0	3.0		0.15			21.39	1.6	1.4	7.9	0.0	0.3			7.9	7.4	11.0
9	32.0	3.1		0.14			12.85	2.8	2.4	7.1	0.0	0.3			7.9	7.4	11.0
10	30.0	3.3		0.23			12.42	3.0	2.6	13.7	0.0	0.3			8.0	2.7	12.0
11	24.0	3.5		0.19	16.5	1.5	11.97	4.2	3.6	6.6	0.0	0.3			7.9	7.5	11.0
12	26.0	3.6		0.19			18.78	4.4	3.8	13.7	0.0	0.3			7.9	7.5	10.5
13	18.0	3.6		0.28			29.99	3.7	3.2	6.6	0.0	0.3			8.0	7.7	9.0
14	20.0	4.4		0.26	18.0	2.0	15.14	5.3	4.6	8.3	0.0	0.3			7.9	7.3	8.0
15	23.0	3.8		0.23			14.90	3.9	3.4	18.0	0.0	0.3			8.0	7.3	10.0
16	25.0	5.5		0.17			22.60	1.3	2.5	16.6	0.0	0.3			8.0	7.4	11.0
17	36.0	3.9		0.15	6.0	5.0	43.12	4.4	3.8	15.8	0.0	0.3			8.0	7.4	11.5
18	41.0	7.0		0.36	29.5	5.5	20.53	2.4	2.1	15.1	0.0	0.3			8.0	7.5	13.0
19	35.0	4.8		0.21	18.0	1.0	17.52	5.9	5.1	6.4	0.0	0.3			8.1	7.5	11.0
20	28.0	4.3		0.21	66.0	4.0	25.64	5.9	5.1	7.1	0.0	0.3			8.0	7.3	11.0
21	66.0	4.5		0.22	8.0	5.0	12.84	3.4	2.9	7.0	0.0	0.3			7.9	7.4	11.0
22	38.0	3.5		0.17			19.52	4.0	3.5	14.4	0.0	0.3			8.0	7.4	10.5
23	32.0	2.5		0.18			26.02	4.3	3.7	14.3	0.0	0.3			7.9	7.3	10.0
24	31.0	4.4		0.20	38.0	1.0	12.22	4.3	3.7	13.5	0.0	0.3			7.9	7.3	9.0
25	38.0	6.4		0.19	45.0	7.5	30.40	3.8	3.2	13.4	0.0	0.3			7.9	7.3	9.5
26	32.0	5.1		0.31	32.0	1.0	43.95	5.8	5.0	13.8	0.0	0.3			8.0	7.3	7.5
27	26.0	6.2		0.61	58.0	9.0	67.07	7.6	5.9	16.4	0.0	0.3			7.9	7.1	6.0
28	24.0	4.0		0.42			54.17	8.7	7.5	14.9	0.0	0.3			8.0	7.2	6.5
29	19.0	3.7		0.24			82.02	13.1	11.3	22.6	0.0	0.5			8.0	7.2	6.0
30	17.0	5.5		0.27			72.86	7.6	6.6	20.1	0.0	0.4			8.0	7.2	5.0
31	13.0	3.7		0.55			40.38	12.1	10.4	17.8	0.0	0.4			8.1	7.1	5.0

NOTE: (1) Sodium Silicate dosage
(2) Sodium Bicarbonate dosage
Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (JAN. 1987)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set	Filter	Treat	Raw	Treat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat	
1	26.0	4.5		0.34			49.50	3.0	2.5	0.0	15.7				8.0	7.8	3.5
2	25.0	4.5		0.39	25.0	3.0	49.50	4.8	4.1	0.0	15.7				8.0	7.7	3.0
3	25.0	5.0		0.35	21.0	3.0	43.30	4.8	4.1	0.0	15.7				8.0	7.7	3.0
4	19.0	6.6		0.28			37.30	4.1	3.5	0.0	15.7				8.0	7.6	2.0
5	17.0	5.4		0.40			37.30	3.2	2.8	0.0	15.7				8.1	7.5	1.0
6	13.0	2.6		0.32	28.0	4.0	37.30	6.0	5.2	0.0	15.7				8.0	7.5	2.0
7	19.0	3.2		0.49	22.0	3.0	37.30	7.6	6.6	0.0	15.7				8.3	8.1	4.0
8	26.0	4.3		0.40	22.0	2.0	37.30	5.8	5.0	0.0	15.7				8.1	8.1	4.0
9	28.0	3.6		0.38			37.30	4.7	4.1	0.0	15.7				8.3	8.2	2.0
10	26.0	2.8		0.42			37.30	5.1	4.4	0.0	15.7				8.2	8.0	2.0
11	27.0	2.3		0.40	15.0	2.0	37.30	4.0	3.5	0.0	15.7				8.2	8.1	2.0
12	50.0	4.0		0.45	14.0	2.0	37.30	3.1	2.7	0.0	15.7				7.9	8.1	1.0
13	14.0	2.1		0.28			37.30	3.1	2.7	0.0	15.7				8.1	8.1	1.0
14	57.0	4.0		0.44	16.0	2.0	37.30	5.8	5.0	0.0	15.7				8.3	8.1	1.5
15	43.0	5.8		0.48	17.0	1.0	37.30	8.1	8.1	0.0	15.7				8.3	8.1	2.0
16	100.0	18.3		0.43			95.90	10.3	8.9	0.0	15.7				7.9	7.5	2.0
17	95.0	8.8		0.38			60.40	8.3	7.1	0.0	15.7				8.0	7.5	2.0
18	54.0	4.8		0.37	68.0	1.0	49.50	5.1	4.4	0.0	15.7				7.9	7.5	2.0
19	48.0	9.3		1.07	42.0	4.0	49.50	5.4	4.7	0.0	15.7				8.1	7.9	1.0
20	26.0	9.8		0.60			49.50	10.4	8.9	0.0	15.7				7.9	7.5	2.0
21	19.0	10.4		0.69			49.50	9.6	8.3	0.0	15.7				7.9	7.5	1.5
22	15.0	9.0		0.67		2.0	74.20	14.6	12.6	0.0	15.7				7.9	7.5	1.0
23	13.0	6.8		0.63		2.0	72.70	7.8	6.8	0.0	15.7				7.9	7.5	1.0
24	14.0	2.9		0.62			49.50	9.5	8.2	0.0	15.7				8.0	7.4	1.0
25	11.0	6.3		0.36			49.50	9.1	7.9	0.0	15.7				8.1	7.2	1.0
26	10.0	3.5		0.31	22.0	3.0	37.30	8.3	7.1	0.0	15.7				7.9	7.9	1.0
27	10.0	3.2		0.33			37.30	9.4	8.1	0.0	15.7				7.9	7.9	1.0
28	11.0	4.1		0.57	15.0	3.5	30.90	9.2	7.9	0.0	15.7				7.9	7.9	1.0
29	12.0	4.4		0.43	15.0	2.0	30.90	8.9	7.7	0.0	15.7				7.7	7.8	2.0
30	12.0	4.6		0.59			37.10	9.4	8.1	0.0	15.7				7.9	7.8	1.0
31	12.0	3.5		0.40			45.20	7.3	6.3	0.0	15.7				7.7	7.9	2.0

NOTE. (1) Sodium Silicate dosage

(2) Sodium Bicarbonate dosage

Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (APRIL 1987)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES. Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set	Filter	Treat	Raw	Treat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat	Raw	Treat	
1	30.0	5.2		0.27			41.60	7.7	6.7	0.0	0.0	0.2			8.1	7.9	7.0
2	56.0	4.6		0.32			29.50	6.6	5.7	0.0	0.0	0.2			8.0	7.8	5.0
3	110.0	9.0		0.45	85.0	3.0	29.50	6.7	5.8	0.0	0.0	0.2			7.9	7.8	4.5
4	98.0	6.9		0.46	89.0	2.0	29.50	6.6	5.7	0.0	0.0	0.2			7.9	7.7	3.5
5	64.0	2.9		0.50			53.00	8.1	7.0	0.0	0.0	0.2			7.9	7.8	4.0
6	140.0	11.6		0.59			53.00	11.6	10.0	0.0	0.0	0.2			7.9	7.1	5.0
7	140.0	16.0		0.30	156.0	6.0	71.20	15.3	13.1	0.0	0.0	0.2			7.7	7.4	5.0
8	100.0	10.0		0.47	100.0	2.0	59.10	8.5	7.3	0.0	0.0	0.2			7.9	7.5	7.0
9	80.0	7.4		0.38			46.90	7.0	6.0	0.0	0.0	0.2			7.7	7.4	8.0
10	65.0	6.9		0.31	80.0	3.0	46.90	5.5	4.8	0.0	0.0	0.2			7.8	7.4	10.0
11	42.0	2.1		0.28	25.0	2.0	35.60	4.5	3.9	0.0	0.0	0.2					8.0
12	28.0	2.5		0.32			35.60	4.3	3.7	0.0	0.0	0.2			8.0	7.3	8.0
13	34.0	5.6		0.29	24.0		35.60	5.8	5.0	0.0	0.0	0.2			8.0	7.4	10.0
14	40.0	2.1		0.29			46.90	6.1	5.2	0.0	0.0	0.2			8.1	7.3	11.0
15	33.0	3.4		0.30			46.90	5.1	4.4	0.0	0.0	0.2			8.0	7.3	11.0
16	31.0	1.8		0.33			46.90	5.1	4.4	0.0	0.0	0.2			7.9	7.4	12.0
17	28.0	2.0		0.30	29.0	1.0	46.90	5.3	4.5	0.0	0.0	0.2			7.9	7.3	12.0
18	26.0	1.7		0.30			46.90	5.9	5.1	0.0	0.0	0.2			8.1	7.3	12.0
19	23.0	2.8		0.31			46.90	3.8	3.3	0.0	0.0	0.2			8.0	7.4	14.0
20	23.0	1.6		0.24			46.90	8.9	7.7	0.0	0.0	0.2			8.1	7.5	12.0
21	28.0	1.3		0.22	18.0	1.0	46.90	5.3	4.6	0.0	0.0	0.2			8.1	7.3	18.0
22	17.0	3.0		0.28	14.0	3.0	35.60	6.6	5.7	0.0	0.0	0.2			8.1	7.5	17.0
23	38.0	4.0		0.31	35.0	2.0	35.60	7.2	6.2	0.0	0.0	0.2			8.1	7.5	16.0
24	34.0	1.5		0.31			35.60	5.2	4.5	0.0	0.0	0.2			8.0	7.5	16.0
25	35.0	2.2		0.40			35.60	3.2	2.8	0.0	0.0	0.2			8.0	7.4	15.0
26	25.0	2.0		0.24			35.60	3.1	2.7	0.0	0.0	0.2			8.2	7.4	15.0
27	16.0	3.0		0.32	15.0	4.5	35.60	3.6	3.1	0.0	0.0	0.2			8.1	7.5	14.5
28	23.0	1.8		0.26			35.60	8.8	7.6	0.0	0.0	0.2			8.0	7.5	13.0
29	25.0	2.0		0.30			35.60	7.2	6.2	0.0	0.0	0.2			8.0	7.4	14.0
30	23.0	2.5		0.28			35.60	5.3	4.6	0.0	0.0	0.2			8.2	7.4	13.0

NOTE: (1) Sodium Silicate dosage
(2) Sodium Bicarbonate dosage
Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (JULY 1987)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set	Filter	Treat	Raw	Treat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat	Raw	Treat.	
1	37.0	2.5		0.24			62.9	6.0	5.1		0.0	0.6			7.8	7.2	24.0
2	37.0	2.7		0.29			62.9	3.0	2.5		0.0	0.6			7.8	7.0	23.5
3	35.0	4.1		0.30	.		62.9	6.1	5.3		0.0	0.6			7.7	6.7	23.0
4	23.0	2.3		0.28	42.0	3.0	62.9	8.0	6.9		0.0	0.6			7.8	7.1	23.0
5	32.0	2.9		0.32			62.9	5.8	5.0		0.0	0.6			7.9	7.2	23.0
6	28.0	2.2		0.29			62.9	6.4	5.5		0.0	0.6			7.7	7.0	24.0
7	24.0	2.7		0.29			62.9	4.7	4.0	4.0	0.0	0.6			7.8	7.1	24.0
8	31.0	2.6		0.31			62.9	4.5	3.9		0.0	0.6			7.5	7.0	24.0
9	35.0	2.4		0.28			62.9	11.0	9.6	16.4	0.0	0.6			7.5	7.0	25.0
10	22.0	2.4		0.35	16.0	2.0	62.9	9.7	8.4	16.4	0.0	0.6			7.8	7.1	25.0
11	18.0	1.2		0.33	18.0	2.0	62.9	11.9	10.3	16.4	0.0	0.6			7.5	7.1	26.0
12	18.0	2.4		0.31			62.9	11.3	9.7	16.4	0.0	0.6			7.5	7.0	27.0
13	16.0	2.3		0.35			62.9	12.5	10.8	16.4	0.0	0.6			7.7	7.1	27.0
14	16.0	1.9		0.29	19.0	3.0	62.9	15.6	13.4	16.4	0.0	0.6			7.8	7.3	27.0
15	29.0	2.8		0.32			62.9	15.5	13.9		0.0	0.6			7.6	7.3	26.0
16	31.0	2.2		0.27			62.9	15.5	5.7	16.4	0.0	0.6			7.8	7.2	25.0
17	32.0	2.1		0.28			62.9	10.3	5.6	16.4	0.0	0.6			7.8	7.1	25.0
18	31.0	1.3		0.30			62.9	15.5	7.1	16.4	0.0	0.6			7.7	7.1	24.5
19	24.0	1.0		0.32			62.9	14.7	6.6		0.0	0.6			7.8	7.1	24.0
20	23.0	1.8		0.29			62.9	14.7	5.8		0.0	0.6			7.7	7.0	25.0
21	31.0	1.3		0.31	23.0	1.0	62.9	19.0	6.3		0.0	0.6			7.8	7.1	26.0
22	33.0	1.4		0.30		3.0	62.9	19.0	5.6		0.0	0.6			7.7	7.1	27.0
23	35.0	1.2		0.31			62.9	25.0	8.4	16.4	0.0	0.6			7.7	7.0	27.0
24	35.0	2.1		0.34			62.9	13.8	5.7		0.0	0.6			7.8	7.1	28.0
25	28.0	1.7		0.31	23.0	5.0	62.9	15.5	7.8		0.0	0.6			7.8	7.1	28.0
26	29.0	1.5		0.28			62.9	13.8	7.8		0.0	0.6			7.8	7.2	28.0
27	55.0	1.8		0.36			62.9	19.8	8.1		0.0	0.6			7.8	7.1	28.0
28	35.0	2.1		0.30			62.9	19.8	7.4	16.4	0.0	0.6			7.8	7.2	27.0
29	36.0	1.6		0.30			62.9	25.9	9.1	16.4	0.0	0.6			–	-	27.0
30	44.0	1.4		0.24			62.9	19.8	7.8	16.4	0.0	0.6			7.8	7.2	28.0
31	31.0	1.8		0.32			62.9	19.8	8.0	16.4	0.0	0.6			7.5	7.1	27.0

NOTE. (1) Sodium Silicate dosage
(2) Sodium Bicarbonate dosage
Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 2.1: PARTICULATE REMOVAL PROFILE (OCT. 1987)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		COAGULANT (ALUM)	COAG AID (1)	COAG AID (2)	PAC	LIME	KMnO4	METAL RES Al (mg/L)		pH		TEMP (DEG C)
	Raw	Set	Filter	Treat	Raw	Treat	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat	Raw	Treat	
1	38.0	3.2		0.38			37.90	8.0	6.9	0.0	0.0	0.7			7.9		17.0
2	37.0	3.5		0.42	21.0	4.0	37.90	7.4	6.4	0.0	0.0	0.7			7.9		15.0
3	36.0	3.5		0.37			37.90	10.0	8.6	0.0	0.0	0.7			8.0		15.0
4	35.0	3.4		0.39			37.90	7.2	6.2	0.0	0.0	0.7			7.9		13.0
5	79.0	16.0		0.37	66.0	8.0	37.90	9.6	8.3	0.0	0.0	0.7			7.9		13.0
6	74.0	11.0		0.37	61.0	5.0	37.90	11.1	9.5	0.0	0.0	0.7			7.9		13.0
7	70.0	6.4		0.35	38.0	4.0	49.90	8.3	7.1	0.0	0.0	0.7			7.9		13.0
8	43.0	5.1		0.28			49.90	7.2	6.2	0.0	0.0	0.7			7.9		12.0
9	37.0	4.3		0.36			49.90	5.0	4.3	0.0	0.0	0.7			7.9		11.0
10	27.0	4.3		0.34			49.90	5.5	4.8	0.0	0.0	0.7			7.9		10.5
11	23.0	2.9		0.42			49.90	7.4	6.4	0.0	0.0	0.7			7.9		10.5
12	25.0	1.9		0.34			49.90	5.4	4.7	0.0	0.0	0.7			7.8		10.0
13	25.0	3.3		0.34	14.0	4.0	49.90	5.4	4.6	0.0	0.0	0.7			7.8		10.0
14	31.0	2.8		0.24		3.5	49.90	6.4	5.5	0.0	0.0	0.7			7.9		10.0
15	29.0	3.9		0.29	15.0	2.0	49.90	5.8	5.0	0.0	0.0	0.7			7.8		10.0
16	32.0	3.4		0.28	12.0	1.0	49.90	5.2	4.4	0.0	0.0	0.7			7.8		10.0
17	35.0	3.2		0.26			49.90	4.6	4.0	0.0	0.0	0.7			7.9		11.0
18	36.0	2.8		0.29		3.5	49.90	3.8	3.3	0.0	0.0	0.7			7.8		11.5
19	33.0	2.0		0.36	17.5		49.90	5.2	4.5	0.0	0.0	0.7			7.8		12.0
20	32.0	4.2		0.42		1.0	49.90	2.4	2.1	0.0	0.0	0.7			7.8		12.0
21	33.0	3.7		0.37	12.0	2.0	49.90	6.7	5.7	0.0	0.0	0.7			7.7		11.5
22	50.0	2.8		0.36	5.0	1.0	49.90	6.1	5.2	0.0	0.0	0.7			7.6		11.0
23	32.0	3.8		0.44	14.0		56.40	6.6	5.7	0.0	0.0	0.7			7.5		10.0
24	36.0	4.6		0.44			56.40	5.0	4.3	0.0	0.0	0.7			7.6		10.0
25	38.0	3.4		0.30		2.0	56.40	6.3	5.5	0.0	0.0	0.7			7.6		10.0
26	84.0	7.8		0.38	12.0	5.0	56.40	8.0	6.9	0.0	0.0	0.7			7.3		10.0
27	69.0	5.3		0.26	46.0		44.30	11.9	10.2	0.0	0.0	0.7			7.5		7.0
28	125.0	20.0		0.44			44.30	4.9	4.2	0.0	0.0	0.7			7.5		8.5
29	100.0	22.0		0.49	102.0	2.0	56.40	9.4	8.1	0.0	0.0	0.7			7.5		8.0
30	90.0	12.0		0.34	70.0	1.0	56.40	13.0	11.2	0.0	0.0	0.7			8.0		7.5
31	63.0	10.0		0.26	51.0	2.0	56.40	9.1	7.8	0.0	0.0	0.7			7.9		7.0

NOTE: (1) Sodium Silicate dosage
(2) Sodium Bicarbonate dosage
Filter turbidity and metal residual not measured

DRESDEN WATER TREATMENT PLANT

TABLE 3.0: DISINFECTION SUMMARY

MONTH	CHEMICAL	1989						1988						1987					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JAN	Cl2 Demand																		
	Cl2 Dosage				1.98	0.74	1.26				3.91	0.83	2.03				2.70	0.82	1.46
	NH3																		
	SO2																		
	Cl2 Resid. Free																		
	Cl2 Resid. Comb																		
	Cl2 Resid. Total				1.40	0.50	1.03				1.50	0.40	1.57				0.45	1.50	1.06
	F- Dosage																		
	F- Res																		
FEB	Cl2 Demand																		
	Cl2 Dosage				1.71	0.45	0.89				3.25	0.77	1.86				2.78	1.00	1.71
	NH3																		
	SO2																		
	Cl2 Resid. Free																		
	Cl2 Resid. Comb																		
	Cl2 Resid. Total				1.40	0.60	1.04				1.50	0.50	1.09				1.50	0.50	1.00
	F- Dosage																		
	F- Res.																		
MAR	Cl2 Demand																		
	Cl2 Dosage				1.26	0.38	0.77				3.46	0.58	1.41				3.13	1.00	1.61
	NH3																		
	SO2																		
	Cl2 Resid. Free																		
	Cl2 Resid. Comb																		
	Cl2 Resid. Total				1.50	0.30	1.01				1.50	0.50	1.34				1.60	0.50	1.11
	F- Dosage																		
	F- Res.																		

NOTE 1 No Pre-chlorination at WTP
2 NH3 and SO2 are not used
3 No Fluoride addition at plant

SOURCE WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3.0: DISINFECTION SUMMARY

MONTH	CHEMICAL	1989						1988						1987					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max	Min.	Avg	Max	Min.	Avg	Max	Min	Avg.	Max	Min.	Avg	Max	Min	Avg	Max	Min	Avg
APR	Cl2 Demand																		
	Cl2 Dosage				2.33	0.70	1.35				2.84	0.47	1.09				2.51	0.70	1.60
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid. Total				1.50	0.60	1.01				1.50	0.60	1.03				1.60	0.30	1.11
	F- Dosage																		
	F- Res																		
MAY	Cl2 Demand																		
	Cl2 Dosage										2.22	0.78	1.36				3.91	0.86	2.09
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid Total				1.20	0.50	0.93				1.70	0.80	1.02				1.50	0.55	1.07
	F- Dosage																		
	F- Res.																		
JUN	Cl2 Demand																		
	Cl2 Dosage										2.73	1.31	2.03				1.50	0.70	1.08
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid Total				1.20	0.60	1.00				1.50	0.60	1.06				1.60	0.50	1.11
	F- Dosage																		
	F- Res																		

NOTE
1 No Pre-chlorination at WTP
2 NH3 and SO2 are not used
3 No Fluoride addition at plant
4 1989 – May to Dec..Cl2 dosage not available

SOURCE WTP Utility Monitoring Records, Sheet B2

TABLE 3.0: DISINFECTION SUMMARY

MONTH	CHEMICAL	1989						1988						1987					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
JUL	Cl2 Demand																		
	Cl2 Dosage										8.33	0 90	2 47				4 00	1 41	2 86
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid Total				1 20	0 80	0 97				1 50	0 40	0 97				1 40	0 55	1 14
	F- Dosage																		
	F- Res																		
AUG	Cl2 Demand																		
	Cl2 Dosage										8 64	2 03	4 15				7 73	1.43	3 60
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid Total				1 40	0 70	1 05				1 50	0 50	1 06				1 50	0 85	1 10
	F- Dosage																		
	F- Res																		
SEP	Cl2 Demand																		
	Cl2 Dosage										4 05	1 39	2 55				3 78	1 15	2 73
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid Total				2 00	1 00	1 16				1 40	0 60	1 03				1 40	0 80	1 06
	F- Dosage																		
	F- Res																		

NOTE
1 No Pre-chlorination at WTP
2 NH3 and SO2 are not used
3 No Fluoride addition at plant
4 1989 - May to Dec Cl2 dosage not available

SOURCE: WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3.0: DISINFECTION SUMMARY

MONTH	CHEMICAL	1989						1988						1987					
		PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION			PRE-CHLORINATION			POST-CHLORINATION		
		Max	Min	Avg	Max	Min.	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
OCT	Cl2 Demand																		
	Cl2 Dosage										2 57	0 77	1 30				3 83	1 22	1 97
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid Total				1 50	1 00	1 11				1 50	0 70	1 04				2 00	0 80	1 07
	F- Dosage																		
	F- Res																		
NOV	Cl2 Demand																		
	Cl2 Dosage										2 33	0 71	1 62				3 16	0 78	1 82
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid Total				1 40	1 00	1 10				1 50	0 60	1 04				1 50	0 40	1 10
	F- Dosage																		
	F- Res																		
DEC	Cl2 Demand																		
	Cl2 Dosage										1 57	0 46	0 88				3 36	1 19	2 03
	NH3																		
	SO2																		
	Cl2 Resid Free																		
	Cl2 Resid Comb																		
	Cl2 Resid Total				1 70	1 00	1 31				1 50	0 50	1 03				1 50	0 60	1 08
	F- Dosage																		
	F- Res																		

NOTE: 1 No Pre-chlorination at WTP
2 NH3 and SO2 are not used
3 No Fluoride addition at plant
4 1989 - May to Dec. Cl2 dosage not available

SOURCE WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3.2. DISINFECTION PROFILE (JAN 1989)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos			Free	Comb.	Total	Dem.	Dos.			Free	Comb	Total		
1									0.93					1 00		
2									1 11					1 00		
3									1 16					0 90		
4									0 85					0 95		
5									1.08					0 95		
6									0.98					1 05		
7									1 00					1 05		
8									1 13					1 10		
9									0.78					1 00		
10									0.90					1 00		
11									0.77					1 07		
12									0.78					1.15		
13									0 74					1 05		
14									1.04					1.10		
15									1 82					1.00		
16									1 75					1.00		
17									1 26					1.10		
18									1.30					1 15		
19									1 45					1 00		
20									1 58					1 00		
21									1 53					1 00		
22									1.98					1 20		
23									1.77					1 20		
24									1 85					1 00		
25									1 48					1 05		
26									1.08					1 30		
27									1 19					0 83		
28									0 93					1 00		
29									1 41					0 90		
30									1 45					1 00		
31									1 90					0 90		

Source WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3 2 DISINFECTION PROFILE (APR 1989)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos			Free	Comb	Total	Dem	Dos			Free	Comb	Total		
1									1 42					1 00		
2									1 55					1 00		
3									1 09					1 00		
4									0 83					1 03		
5									1 06					0 95		
6									0 84					0 85		
7									1 17					1 00		
8									1 49					1 05		
9									2 33					1 00		
10									1 10					1 25		
11									0 70					1 30		
12									1 10					1 15		
13									1 13					1 10		
14									1 18					1 00		
15									1 72					1 05		
16									1 10					0 60		
17									1 36					1 00		
18									1 74					1 00		
19									2 05					1 00		
20									1.31					1 00		
21									1 73					1 00		
22									1 94					1 00		
23									1 44					1 00		
24									1 03					1 05		
25									1 26					1 00		
26									0 99					1 00		
27									1 46					1 00		
28									1 21					1 00		
29									1 48					1 00		
30									1 70					1 00		

Source WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3 2· DISINFECTION PROFILE (JUL 1989)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos.	Res
	Dem	Dos			Free	Comb	Total	Dem.	Dos			Free	Comb.	Total		
1														1 00		
2														0 90		
3														1.00		
4														1.00		
5														1.00		
6														0 95		
7														0 90		
8								Dosages						0 90		
9														1.00		
10								Not						1 00		
11														1 00		
12								Available						0 90		
13														1 00		
14														1 00		
15														1 00		
16														1.00		
17														1 00		
18														0 95		
19														1 00		
20														1 05		
21														0 90		
22														0 85		
23														0 90		
24														0 90		
25														1 00		
26														1 00		
27														1 00		
28														0 80		
29														1 00		
30														1 00		
31														1 10		

Source WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3 2 DISINFECTION PROFILE (OCT 1989)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos			Free	Comb	Total	Dem	Dos			Free	Comb	Total		
1														1 20		
2														1 15		
3														1 00		
4														1 05		
5														1 10		
6														1 05		
7														1 00		
8								Dosages						1 00		
9														1 00		
10								Not						1 50		
11														1 00		
12								Available						1 20		
13														1 10		
14														1 20		
15														1 10		
16														1 20		
17														1 10		
18														1 00		
19														1 10		
20														1 15		
21														1 05		
22														1 20		
23														1 20		
24														1 10		
25														1 20		
26														1 10		
27														1 00		
28														1 00		
29														1 05		
30														1 10		
31														1 10		

Source WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3.2 DISINFECTION PROFILE (JAN. 1988)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos.	Res
	Dem	Dos			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1									1.85					1.20		
2									1.54					1.10		
3									1.88					1.10		
4									1.57					1.20		
5									1.48					0.95		
6									2.25					1.15		
7									1.54					0.90		
8									1.99					1.00		
9									1.69					1.10		
10									1.34					1.05		
11									2.16					1.00		
12									3.30					1.07		
13									1.01					1.07		
14									2.11					1.10		
15									1.71					1.15		
16									2.02					1.10		
17									1.51					1.10		
18									1.67					2.00		
19									2.18					2.19		
20									3.91					3.90		
21									2.70					2.73		
22									2.99					2.99		
23									2.77					2.78		
24									2.01					2.00		
25									1.89					1.48		
26									1.57					2.15		
27									2.04					1.90		
28									1.85					2.25		
29									2.07					2.32		
30									3.40					1.07		
31									0.83					0.56		

Source: WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3 2 DISINFECTION PROFILE (APR 1988)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos.			Free	Comb	Total	Dem.	Dos.			Free	Comb	Total		
1									1.00					1.30		
2									0.48					1 00		
3									0 89					1 00		
4									1 14					0 85		
5									1 60					0 60		
6									1 06					1 20		
7									1 33					0 90		
8									0 84					1 05		
9									0 86					1.10		
10									0.75					1 00		
11									0.86					1 00		
12									1.11					1 30		
13									1 39					0 90		
14									1 49					1 00		
15									2 84					1 00		
16									1 04					1 00		
17									0 94					1 25		
18									0 95					1.00		
19									1.22					0 90		
20									0 90					0 80		
21									1 36					1.00		
22									1 43					1.20		
23									0 47					1 00		
24									1 23					1 25		
25									1 18					1 00		
26									1 19					1 00		
27									0 57					1 25		
28									1 03					0 90		
29									0 58					1 00		
30									0 99					1 00		

Source: WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3.2: DISINFECTION PROFILE (JUL. 1988)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos			Free	Comb.	Total	Dem	Dos.			Free	Comb	Total		
1									2.09					1.00		
2									2.06					1.05		
3									2.39					1.05		
4									2.20					1.05		
5									1.98					1.05		
6									2.68					1.10		
7									1.41					1.00		
8									1.63					1.10		
9									1.51					1.00		
10									1.61					1.05		
11									2.06					1.00		
12									2.08					1.00		
13									1.77					1.00		
14									0.90					1.00		
15									2.17					0.50		
16									1.72					0.55		
17									1.20					0.70		
18									1.25					1.00		
19									1.35					0.80		
20									1.51					1.00		
21									2.32					0.70		
22									3.44					1.25		
23									2.61					0.60		
24									2.61					0.60		
25									2.60					1.00		
26									4.92					1.15		
27									5.62					1.10		
28									8.33					1.25		
29									3.01					1.25		
30									4.00					1.15		
31									1.64					1.05		

Source: WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3 2. DISINFECTION PROFILE (OCT. 1988)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos			Free	Comb	Total	Dem	Dos			Free	Comb	Total		
1									1.85					1.00		
2									1.36					0.90		
3									0.91					0.95		
4									0.97					0.95		
5									1.44					1.25		
6									0.88					1.10		
7									0.83					1.10		
8									0.86					1.00		
9									0.51					0.90		
10									0.75					0.90		
11									0.96					1.10		
12									0.87					1.10		
13									1.08					1.10		
14									1.36					1.10		
15									1.19					1.00		
16									1.05					1.00		
17									1.01					1.00		
18									1.23					0.90		
19									1.52					1.00		
20									1.54					1.00		
21									0.77					0.90		
22									0.91					1.00		
23									0.91					1.00		
24									0.98					1.10		
25									1.58					1.00		
26									1.63					1.00		
27									1.79					1.20		
28									2.57					1.00		
29									2.26					1.10		
30									2.37					1.20		
31									2.26					1.30		

Source WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3 2 DISINFECTION PROFILE (JAN 1987)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos.	Res
	Dem	Dos.			Free	Comb	Total	Dem	Dos.			Free	Comb.	Total		
1									1.34					1.37		
2									1.00					1.03		
3									1.00					0.95		
4									1.02					1.03		
5									1.13					1.05		
6									1.12					1.05		
7									1.97					1.03		
8									0.99					1.05		
9									1.22					1.07		
10									1.15					1.00		
11									0.82					1.05		
12									1.43					1.40		
13									1.26					1.20		
14									1.48					1.20		
15									1.43					1.05		
16									1.40					0.82		
17									1.25					0.95		
18									1.42					1.00		
19									1.38					0.90		
20									1.41					0.80		
21									1.56					0.73		
22									1.92					1.00		
23									1.62					1.00		
24									2.70					1.05		
25									1.66					1.25		
26									1.53					1.20		
27									1.86					1.10		
28									1.99					1.00		
29									1.65					1.10		
30									2.24					1.10		
31									1.48					1.20		

Source. WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3 2 DISINFECTION PROFILE (APR. 1987)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos			Free	Comb	Total	Dem.	Dos			Free	Comb	Total		
1									1 68					1 48		
2									1 27					1 18		
3									1.61					0 66		
4									1 33					1 00		
5									1 76					1 00		
6									2 23					1 10		
7									2.15					1 20		
8									1 84					1 07		
9									1 80					1 23		
10									1 89					1.20		
11									1 58					1.10		
12									0 99					0 90		
13									1.75					0.87		
14									1 53					1.30		
15									1 23					1 00		
16									0 93					0 97		
17									1 11					1.15		
18									1 26					0 95		
19									1.74					1.05		
20									2 51					0.73		
21									1 51					1 27		
22									1.71					0 90		
23									2.38					1.05		
24									1 90					1 40		
25									2.19					1.35		
26									0 70					1 30		
27									1 13					1 17		
28									1 33					1.02		
29									1 77					1.20		
30									1 26					1 40		

Source WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3.2. DISINFECTION PROFILE (JUL. 1987)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos			Free	Comb	Total	Dem	Dos			Free	Comb.	Total		
1									2.86					1.20		
2									3.12					1.20		
3									2.57					1.07		
4									2.66					0.82		
5									3.04					0.99		
6									2.76					1.20		
7									1.41					1.27		
8									1.84					1.10		
9									1.99					1.05		
10									2.33					1.30		
11									2.50					1.06		
12									2.98					1.05		
13									3.51					1.23		
14									2.91					1.20		
15									3.66					1.30		
16									2.67					1.23		
17									2.94					1.20		
18									3.09					1.30		
19									2.25					1.10		
20														1.17		
21									2.73					1.17		
22									2.92					1.15		
23									3.34					1.10		
24									2.62					1.13		
25									3.66					1.10		
26									3.09					0.88		
27									3.34					1.27		
28									2.72					1.10		
29									2.88					1.05		
30									3.37					1.30		
31									4.00					1.20		

Source: WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 3 2 DISINFECTION PROFILE (OCT 1987)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl2		NH3	SO2	RESIDUAL Cl2			Cl2		NH3	SO2	RESIDUAL Cl2			Dos	Res
	Dem	Dos			Free	Comb	Total	Dem	Dos			Free	Comb	Total		
1									2 11					1 05		
2									1 76					1 15		
3									3 83					1 05		
4									1 34					1 05		
5									1 54					0 98		
6									2 21					1 02		
7									3 75					1 06		
8									2 35					1 05		
9									1 93					1 10		
10									1 82					1 30		
11									1 86					1 25		
12									1 22					0 85		
13									2 14					1 10		
14									1 83					1 30		
15									1 64					1 30		
16									1 46					1 10		
17									1.39					0 95		
18									1 20					1 00		
19									1 62					1 00		
20									1 56					0 95		
21									2 01					1 05		
22									2 03					1 10		
23									1 65					1 10		
24									1 31					1 15		
25									1 60					1 05		
26									1 92					1 22		
27									2 06					1 10		
28									2 81					1 03		
29									2 64					1 00		
30									2 35					0 95		
31									2 13					0 93		

Source WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

GENERAL CHEMISTRY		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
ALKALINITY	R	171.6	194	0.2	
(mg/L)	T	154	174.3		
AMMONIUM	R	0.002		0.05	
(mg/L)	T	0.016			
CALCIUM	R	74.4	106	0.1	
(mg/L)	T	76.4	107		
CHLORIDE	R	21	39	0.2	250
(mg/L)	T	24	40.8		
COLOUR	R	12	29.5	0.5	5
(TCU)	T	7	8		
CONDUCTIVITY	R	505	543	0.01	
(umho/cm)	T	700	724		
FIELD CHLORINE	R			0.1	
(COMBINED)	T	0.2	0.2		
(mg/L)					
FIELD CHLORINE	R			0.1	
(FREE) (mg/L)	T	1	0.7		
FIELD CHLORINE	R			0.1	
(TOTAL) (mg/L)	T	1.2	0.9		
FIELD pH	R	7.6	7.7	0.2	
	T	9	7.2		
FIELD TEMPERATURE	R	23	10		
(C)	T	23	10		
FIELD TURBIDITY	R		76		1
(FTU)	T	0.32	0.31		
FLUORIDE	R	0.2	0.1	0 01	2.4
(mg/L)	T	0.16	0.1		

SOURCE Drinking Water Surveillance Program – Annual Report 1987

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

GENERAL CHEMISTRY (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
HARDNESS	R	242	347	0.5	
(mg/L)	T	247	346		
MAGNESIUM	R	13.6	19.7	0.05	c
(mg/L)	T	13.5	19.5		
NITRATE	R	4.29	4.79	0.05	10
(mg/L)	T	4.17	11.7		as N
NITRITE	R	0.019	0.063	0.005	1
(mg/L)	T	0.003	0.001		as N
NITROGEN TKN	R	0.8	1.13	0.1	0.15 *
(mg/L)	T	0.5	0.62		
pH	R	8.25	8.28		
	T	7.93	8.2		
PHOSPHORUS FILTERED REACTIVE (mg/L)	R	0.012	0.045	0.01	
	T	BDL	0.001		
PHOSPHORUS TOTAL (mg/L)	R	0.095	0.12	0.01	
	T	0.006	0.004		
SODIUM	R	8	13.8	0.1	
(mg/L)	T	11	18.4		
TOTAL SOLIDS	R			1	
(mg/L)	T				
TURBIDITY	R	68	82	0.01	1
(FTU)	T	0.23	0.17		

SOURCE: Drinking Water Surveillance Program – Annual Report 1987

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

METALS		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
ALUMINUM	R	1.2	1.9	0.003	
(mg/L)	T	0.69	0.049		
ARSENIC	R	BDL		0.001	0.05
(mg/L)	T				
BARIUM	R	0.046	0.041	0.001	1
(mg/L)	T	0.038	0.029		
BERYLIUM	R	BDL		0.001	
(mg/L)	T				
BORON	R	0.07	0.06	0.02	5
(mg/L)	T	0.08	0.07		
CADMIUM	R	BDL		0.0003	0.005
(mg/L)	T				
CHROMIUM	R	0.002	0.005	0.001	0.05
(mg/L)	T	BDL	0.003		
COBALT	R	BDL	0.002	0.001	
(mg/L)	T	0.001	BDL		
COPPER	R	0.028	0.018	0.001	1
(mg/L)	T	0.004	0.002		
CYANIDE	R	BDL		0.001	0.2
(mg/L)	T				
IRON	R	2	2	0.002	0.3 c
(mg/L)	T	0.15	BDL		
LEAD	R	0.011	BDL	0.003	0.05
(mg/L)	T	0.011	BDL		
MANGANESE	R	0.11	0.05	0.001	0.05
(mg/L)	T	0.52	0.021		

SOURCE: Drinking Water Surveillance Program – Annual Report 1987

DRESDEN WATER TREATMENT PLANT

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

METALS (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
MOLYBDENUM	R	BDL	0.001	0.001	
(mg/L)	T	0.002	0.002		
MERCURY	R	BDL	0.02	0.01	1
(Ug/L)	T	BDL	0.02		
NICKEL	R	0.003	0.004	0.002	
(mg/L)	T	0.002	0.002		
SELENIUM	R	BDL		0.001	0.01
(mg/L)	T				
STRONTIUM	R	0.18	0.2	0.001	
(mg/L)	T	0.18	0.2		
TIN	R				
(mg/L)	T				
URANIUM	R	1.68	3.56	0.002	0.02 t
(mg/L)	T	0.12	2.98		
VANADIUM	R	0.003	0.014	0.001	
(mg/L)	T	0.001	BDL		
ZINC	R	0.012	0.013	0.001	5 h
(mg/L)	T	0.02	0.004		

SOURCE: Drinking Water Surveillance Program – Annual Report 1987

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

PURGEABLES		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
BENZENE	R	BDL		1	10 h
(ug/L)	T				
BROMOFORM	R	BDL		1	350 ++
(ug/L)	T				
CARBON TETRACHLORIDE	R	BDL		1	3 h
(ug/L)	T				
CHLOROBENZENE	R	BDL		1	100-300 h*
(ug/L)	T				
CHLORO-DIBROMOMETHANE	R	BDL	BDL	1	350 ++
(ug/L)	T	4	2.9		
CHLOROFORM	R	BDL	BDL	1	350 ++
(ug/L)	T	90	50		
1,2-DICHLORO-BENZENE	R	BDL		1	400 e
(ug/L)	T				
1,3-DICHLORO-BENZENE	R	BDL		1	400 e
(ug/L)	T				
1,4-DICHLORO-BENZENE	R	BDL		1	400 e
(ug/L)	T				
DICHLOROBROMO-METHANE	R	BDL	BDL	1	350 ++
(ug/L)	T	18	17		

SOURCE. Drinking Water Surveillance Program – Annual Report 1987

DRESDEN WATER TREATMENT PLANT

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

PURGEABLES (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
1,1-DICHLORO- ETHANE (ug/L)	R	BDL		1	
	T				
1,2-DICHLORO- ETHANE (ug/L)	R	BDL		1	10 h
	T				
1,1-DICHLORO- ETHYLENE (ug/L)	R	BDL		1	.3 h
	T				
t 1,2-DICHLORO- ETHYLENE (ug/L)	R	BDL		1	
	T				
DICHLOROMETHANE (ug/L)	R	BDL		5	40 c
	T				
1,2-DICHLORO- PROPANE (ug/L)	R	BDL		1	
	T				
ETHYLBENZENE (ug/L)	R	BDL	BDL	1	1400 e
	T	BDL	.1<T		
ETHYLENE DIBROMIDE (ug/L)	R	BDL			
m-XYLENE (ug/L)	R	BDL		1	620 c
	T				
o-XYLENE (ug/L)	R	BDL		1	620 c
	T				

SOURCE. Drinking Water Surveillance Program – Annual Report 1987

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

PURGEABLES (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
p-XYLENE	R	BDL		1	620 c
(ug/L)	T				
TOLUENE	R	BDL	.05<T	1	100 c
(ug/L)	T	BDL	BDL		
1,1,2,2-TETRA-	R	BDL		1	1.7 e
CHLOROETHANE	T				
(ug/L)					
TETRACHLORO-	R	BDL		1	10 h
ETHYLENE	T				
(ug/L)					
1,1,1-TRICHLORO-	R	BDL		1	1000 c
ETHANE	T				
(ug/L)					
1,1,2-TRICHLORO-	R	BDL		1	6 e
ETHANE	T				
(ug/L)					
TRICHLORETHYLENE	R	BDL		1	30 h
(ug/L)	T				
TOTAL TRIHALO-	R	BDL	BDL	3	350 ++
METHANE	T	112	69.9		
(ug/L)					
TRIFLUOROCHLORO-	R	BDL		1	
TOLUENE	T				
(ug/L)					

SOURCE Drinking Water Surveillance Program – Annual Report 1987

DRESDEN WATER TREATMENT PLANT

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

ORGANOCHLORINES		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
ALDRIN	R	BDL		1	700 **
(ng/L)	T				
ALPHA BHC	R	1.0<T	!IS	1	700 c
(ng/L)	T	BDL	!IS		
ALPHA CHLORDANE	R	BDL		2	700 ***
(ng/L)	T				
BETA BHC	R			1	300 c
(ng/L)	T				
DIELDRIN	R	BDL		2	700 **
(ng/L)	T				
ENDRIN	R	BDL		4	200
(ng/L)	T				
GAMMA CHLORDANE	R	BDL		2	700 ***
(ng/L)	T				
HEPTACHLOR EPOXIDE	R	BDL		1	3000 +++
(ng/L)					
HEPTACHLOR	R	BDL		1	3000 +++
(ng/L)	T				
HEXACHLORO-BENZENE	R			1	10 h
(ng/L)	T				
HEXACHLORO-BUTADIENE	R	BDL			
(Ug/L)	T				
HEXACHLORO-ETHANE	R	BDL		1	19000 e
(ng/L)	T				
LINDANE	R	3.0<T	!IS	1	4000
(ng/L)	T	2.0<T	!IS		

SOURCE Drinking Water Surveillance Program – Annual Report 1987

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

ORGANOCHLORINES (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
METHOXYCHLOR	R	BDL		5	100000
(ng/L)	T				
MIREX	R	BDL		5	
(ng/L)	T				
OCTACHLORO-STYRENE	R	BDL		1	
(ng/L)	T				
o,p-DDT	R	BDL		5	30000 d
(ng/L)	T				
OXYCHLORDANE	R	BDL		2	
(ng/L)	T				
PCB TOTAL	R	BDL		20	3000 t
(ng/L)	T				
PENTACHLORO-BENZENE	R	BDL		1	74000 e
(ng/L)	T				
p,p-DDD	R	BDL		5	d
(ng/L)	T				
p,p-DDE	R	BDL		1	d
(ng/L)	T				
p,p-DDT	R	BDL		5	d
(ng/L)	T				

SOURCE Drinking Water Surveillance Program – Annual Report 1987

DRESDEN WATER TREATMENT PLANT

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

ORGANOCHLORINES (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
1,2,3,4-TETRA-CHLOROBENZENE (ng/L)	R	BDL		1	
	T				
1,2,3,5-TETRA-CHLOROBENZENE (ng/L)	R	BDL		1	
	T				
1,2,4,5-TETRA-CHLOROBENZENE (ng/L)	R	BDL		1	38000 e
	T				
THIODAN 1 (ng/L)	R	BDL		2	74000 ea
	T				
THIODAN 2 (ng/L)	R	BDL		4	74000 ea
	T				
THIODAN SULPHATE (ng/L)	R	BDL		4	
	T				
TOXAPHENE	R	BDL			
	T				
1,2,3-TRICHLORO-BENZENE (ng/L)	R	BDL		5	10000 y
	T				
1,2,4-TRICHLORO-BENZENE (ng/L)	R	BDL		5	15000 y
	T				
1,3,5-TRICHLORO-BENZENE (ng/L)	R	BDL		5	10000 y
	T				

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

ORGANOCHLORINES (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
2,3,6-TRICHLORO-TOLUENE (ng/L)	R T	BDL		5	
2,4,5-TRICHLORO-TOLUENE (ng/L)	R T	BDL		5	10000 g
2,6,A-TRICHLORO-TOLUENE (ng/L)	R T	BDL		5	

SOURCE Drinking Water Surveillance Program – Annual Report 1987

DRESDEN WATER TREATMENT PLANT

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

TRIAZINES		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
ALACHLOR	R	BDL			
(ng/L)	T				
AMETRINE	R	BDL		50	
(ng/L)	T				
ATRATONE	R	BDL			
(ng/L)	T				
ATRAZINE	R	14400	BDL	50	46000 I
(ng/L)	T	13900	BDL		
BLADEX	R	3200	BDL	100	10000 I
(ng/L)	T	3680	BDL		
METOLACHLOR	R	9020	BDL		
(ng/L)	T	6650	BDL		
PROMETONE	R	BDL		50	
(ng/L)	T				
PROMETRYNE	R	BDL		50	1000 I
(ng/L)	T				
PROPAZINE	R	BDL		50	
(ng/L)	T				
SENCOR	R	BDL		100	
(ng/L)	T				
SIMAZINE	R	BDL		50	10000 I
(ng/L)	T				

SOURCE Drinking Water Surveillance Program – Annual Report 1987

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

SPECIAL PESTICIDES		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
2,4-D	R	BDL		100	100000
(ng/L)	T				
2,4-D BUTYRIC ACID	R			200	18000 !
(ng/L)	T				
DICAMBA	R	BDL	BDL	100	87000 !
(ng/L)	T	480<T	!LA		
PENTACHLORO-	R	BDL	BDL	50	10000 h
PHENOL	T	10<T	BDL		
(ng/L)					
PICLORAM	R	BDL		100	
(ng/L)	T				
2,4-D PROPIONIC	R			100	
ACID	T				
(ng/L)					
SILVEX	R	BDL		50	10000
(ng/L)	T				
2,4,5-T	R	BDL		50	
(ng/L)	T				
2,3,4,5-TETRA-	R	BDL		50	
CHLOROPHENOL	T				
(ng/L)					
2,3,5,6-TETRA-	R	BDL		50	
CHLOROPHENOL	T				
(ng/L)					

SOURCE Drinking Water Surveillance Program – Annual Report 1987

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

SPECIAL PESTICIDES (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
2,3,4-TRICHLORO-PHENOL (ng/L)	R T	BDL		100	
2,4,5-TRICHLORO-PHENOL (ng/L)	R T	BDL		50	
2,4,6-TRICHLORO-PHENOL (ng/L)	R T	BDL		50	10000 h

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

ORGANOPHOSPHOROUS PESTICIDES		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
DIAZINON	R	BDL		50	14000
(ng/L)	T				
DICHLOROVOS	R	BDL			
(ng/L)	T				
DURSBAN	R	BDL			
(ng/L)	T				
ETHION	R	BDL			
(ng/L)	T				
GUTHION	R	BDL			
(ng/L)	T				
MALATHION	R	BDL			
(ng/L)	T				
METHYLPARATHION	R	BDL		50	7000
(ng/L)	T				
METHYLTRITHION	R	BDL			
(ng/L)	T				
MEVINPHOS	R	BDL			
(ng/L)	T				
PARATHION	R	BDL		50	35000
(ng/L)	T				
PHORBATE	R	BDL			
(ng/L)	T				
RELDAN	R	BDL			
(ng/L)	T				
RONNEL	R	BDL			
(ng/L)	T				

SOURCE Drinking Water Surveillance Program – Annual Report 1987

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

MASS SPEC.		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
DI-N-BUTYL PHTHALATE (ug/L)	R			0.1	34000 e
	T				
n-DICHLOROMETHYLENE-PENTACHLORANALINE (ug/L)	R			0.1	
	T				
DIPHENYL ETHER (ug/L)	R			0 1	
	T				
FLUORANTHENE (ug/L)	R			0 1	
	T				
HEXACHLOROPROPENE (ug/L)	R			0 1	
	T				
METHYL PHENANTHRENE (ug/L)	R			0.1	
	T				
NAPHTHALENE (ug/L)	R			0.1	
	T				
PENTACHLORO-BUTADIENE (ug/L)	R			0 1	
	T				
PENTACHLORO-PROPANE (ug/L)	R			0.1	
	T				
PENTACHLORO-PROPENE (ug/L)	R			0.1	
	T				

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

MASS SPEC. (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
PYRENE	R			0.1	
(ug/L)	T	BDL			
TETRACHLORO-	R			0.1	
BUTANE	T				
(ug/L)					
TETRACHLORO-	R			0.1	
BIPHENYL	T				
(ug/L)					

SOURCE Drinking Water Surveillance Program – Annual Report 1987

DRESDEN WATER TREATMENT PLANT

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

BACTERIA		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
RAW WATER					
TOTAL COLIFORM MF (count/100mL)	R	600 A3C	13200 A3C		
TOTAL COLIFORM BACKGROUND (count/mL)	R	33000	60000		
FECAL COLIFORM MF (count/100mL)	R	>150	92	0	0/0.1 mL
STANDARD PLATE COUNT MF (count/100mL)	R	2400	>2400	0	500
TREATED WATER:					
TOTAL COLIFORM BACKGROUND MF (count/100mL)	T	0	0	0	OWDO bacti
FECAL COLIFORM MF (count/100mL)	T	-	-	0	OWDO bacti
STANDARD PLATE COUNT MF (count/100mL)	T	4	3		
PRESENT/ABSENT TEST	T	0	0		

TABLE 4.0: WATER QUALITY – 1 YEAR SUMMARY (1987)

BACTERIA (Cont'd)		JUNE	NOVEMBER	DWSP DETECTION LIMIT *	DRINKING WATER OBJECTIVES GUIDELINES (1)
IF PRESENT/ABSENT TEST POSITIVE:					
COLIFORM P/A	T				
FECAL COLIFORM P/A	T				
E. COLI P/A	T				
AROMONAS P/A	T				
STAPH. AUREUS P/A	T				

SOURCE Drinking Water Surveillance Program – Annual Report 1987

DRESDEN WATER TREATMENT PLANT

TABLE A – FOOTNOTES

1 – See individual footnotes for Agency of Guideline origin
c – California State Department of Health Action Level
d – OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e – USEPA ambient guideline
ea – United States Environmental Protection Agency (USEPA) ambient
level for endolsufan (contains other isomers)
ap – USEPA proposed maximum contaminant level for drinking water
g – suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h – World Health Organization (WHO) guideline
h* – World Health Organization (WHO) odour threshold
mg/L – milligrams per litre, parts per million (ppm)
ng/L – nanograms per litres, parts per trillion (ppt)
Presence/Absence – microbiological test to indicate presence or absence of coliform bacteria
R – raw water
T – treated drinking water
t – ODWO interim maximum acceptable concentration, (IMAC)
ug/L – micrograms per litre, parts per billion (ppb)
y – New York State (Taste & Odour) proposed drinking water guideline
* – if other than DWSP Detection Limit
** – total of Aldrin and Dieldrin
*** – Chlordane is a mixture of alpha and gamma isomers
++ – total Trihalomehtanes
+++ – combined total: Heptachlor and Heptachlor Epoxide
! – Ministry of the Environment and Health and Welfare Canada, (IMAC)
<T – greater than detection limit but not confident
!IS – No data: insufficient sample
!LA – No data: laboratory accident

TABLE 5.0: ALGAE COUNT

MONTH	COUNT	1989	1988	1987
JAN	Max.			
	Min.			
	Avg.			
	No. Tests			
FEB	Max.			
	Min.			
	Avg.			
	No. Tests			
MAR	Max.			
	Min.	No Algae Counts Conducted for WTP		
	Avg.			
	No. Tests			
APR	Max.			
	Min.			
	Avg.			
	No. Tests			
MAY	Max.			
	Min.			
	Avg.			
	No. Tests			
JUN	Max.			
	Min.			
	Avg.			
	No. Tests			

TABLE 5.0: ALGAE COUNT

MONTH	COUNT	1989	1988	1987
JUL	Max.			
	Min.			
	Avg.			
	No. Tests			
AUG	Max.			
	Min.			
	Avg.			
	No. Tests			
SEP	Max.			
	Min.	No Algae Counts Conducted for WTP		
	Avg.			
	No. Tests			
OCT	Max.			
	Min.			
	Avg.			
	No. Tests			
NOV	Max.			
	Min.			
	Avg.			
	No. Tests			
DEC	Max.			
	Min.			
	Avg.			
	No. Tests			

DRESDEN WATER TREATMENT PLANT

TABLE 6.0: BACTERIOLOGICAL TESTING 1989

MONTH	R/T	TOTAL COLIFORM				FECAL COLIFORM				FECAL STREPTOCOCCUS			
		ABSENT	0-100	101-5000	>5000	ABSENT	0-10	11-500	>500	ABSENT	0-1	2-50	>50
JAN	R			3	3			4	2		1		5
	T	5				5				5			
FEB	R			4	1		1	3	1			4	1
	T	4				4				4			
MAR	R			3	1		2	2				3	1
	T	4				4				4			
APR	R			4				3	1		1	1	2
	T	4				4				4			
MAY	R			4			1	3	1		1	3	1
	T	5				5				5			
JUN	R			3	1			3	1				4
	T	4				4				4			
JUL	R			4			2	2				3	1
	T	4				4				4			
AUG	R			2			2	3				3	2
	T	5				5				5			
SEP	R			4			1	3					4
	T	4				4				4			
OCT	R			2	1		1	2				1	2
	T	3				3				3			
NOV	R				5			4	1			1	4
	T	5				5				5			
DEC	R			2	1			3				1	2
	T	3				3				3			

NOTE: All results are for 100 mL samples. Tests carried out at MOE lab, London
R = Raw; T = Treated

SOURCE: Data from WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 6.1: BACTERIOLOGICAL TESTING 1988

MONTH	R/T	TOTAL COLIFORM				FECAL COLIFORM				FECAL STREPTOCOCCUS			
		ABSENT	0-100	101-5000	>5000	ABSENT	0-10	11-500	>500	ABSENT	0-1	2-50	>50
JAN	R			3	1		4					2	2
	T	4				4				4			
FEB	R			5				4	1			3	2
	T	5	2			5				5			
MAR	R		1	4			1	4				2	3
	T	5				5				5			
APR	R			4			1	2				2	2
	T	5				5				5			
MAY	R			4	1			1	4			5	
	T	6				6				6			
JUN	R		3				1	2				3	
	T	3				3				3			
JUL	R		1	3				4				3	1
	T	4				4				4			
AUG	R			5			1	3	1			3	2
	T	5				5				5			
SEP	R			4	1			5				1	4
	T	5				5				5			
OCT	R			4				4					4
	T	4				4				4			
NOV	R			1	3			2	2			1	2
	T	4				4				4			
DEC	R		1	3			1	2	1			2	2
	T	4				4				4			

NOTE: All results are for 100 mL samples. Tests carried out at MOE lab, London
R = Raw; T = Treated

SOURCE: Data from WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 6.2: BACTERIOLOGICAL TESTING 1987

MONTH	R/T	TOTAL COLIFORM				FECAL COLIFORM				FECAL STREPTOCOCCUS			
		ABSENT	0-100	101-5000	>5000	ABSENT	0-10	11-500	>500	ABSENT	0-1	2-50	>50
JAN	R			4				4				2	2
	T	4											
FEB	R		1	3				4			1	1	2
	T	4											
MAR	R			4			1	3				2	2
	T	4											
APR	R		1	2	1			4				2	2
	T	4											
MAY	R		2	2			1	3			2	2	
	T	4											
JUN	R			5				5				1	2
	T	5											
JUL	R		3	1				4				2	2
	T	4											
AUG	R		4				4					1	3
	T	4											
SEP	R		1	2	2		5						5
	T	5											
OCT	R		1	1	2			2	2			2	2
	T	4				4				4			
NOV	R				4		1		3				4
	T	4				4				4			
DEC	R				5			2	3				
	T	5				5				5			

NOTE: All results are for 100 mL samples. Tests carried out at MOE lab, London
R = Raw; T = Treated

SOURCE: Data from WTP Utility Monitoring Records, Sheet B2

DRESDEN WATER TREATMENT PLANT

TABLE 7.0: ONTARIO DRINKING WATER OBJECTIVES INCLUDING ALUMINUM (TREATED WATER AT PLANT)

DATE	PARAMETER	MEASURED PARAMETER	OBJECTIVE LIMIT
5 Dec 1989	Colour	7 Hazen units	5 Hazen units
12 Dec 1989	Turbidity	1.22 FTU	1.0 FTU
15 Dec 1989	Turbidity	1.4 FTU	1.0 FTU
1 Nov 1989	Colour	5.5 Hazen units	5 Hazen units
8 Nov 1989	Colour	8.5 Hazen units	5 Hazen units
15 Nov 1989	Colour	5.5 Hazen units	5 Hazen units
17 Nov 1989	Turbidity	1.04 FTU	1.0 FTU
18 Nov 1989	Turbidity	1.05 FTU	1.0 FTU
19 Nov 1989	Turbidity	2.4 FTU	1.0 FTU
20 Nov 1989	Turbidity	1.41 FTU	1.0 FTU
21 Nov 1989	Colour	11 Hazen units	5 Hazen units
29 Nov 1989	Colour	6 Hazen units	5 Hazen units
23 Oct 1989	Turbidity	1.3 FTU	1.0 FTU
23 Oct 1989	Colour	5.5 Hazen units	5 Hazen units
6 Sep 1989	Colour	5.5 Hazen units	5 Hazen units
7 Sep 1989	Turbidity	1.38 FTU	1.0 FTU
12 Sep 1989	Colour	5.5 Hazen units	5 Hazen units
1 Aug 1989	Colour	7 Hazen units	5 Hazen units
8 Aug 1989	Colour	6 Hazen units	5 Hazen units
16 Aug 1989	Colour	7 Hazen units	5 Hazen units
22 Aug 1989	Colour	8 Hazen units	5 Hazen units
4 July 1989	Colour	6.5 Hazen units	5 Hazen units
12 July 1989	Colour	7 Hazen units	5 Hazen units
18 July 1989	Colour	5.5 Hazen units	5 Hazen units
26 July 1989	Colour	6 Hazen units	5 Hazen units
6 June 1989	Colour	9.5 Hazen units	5 Hazen units

SOURCE: Data from WTP Utility Monitoring Records

TABLE 7.0: ONTARIO DRINKING WATER OBJECTIVES
INCLUDING ALUMINUM (TREATED WATER AT PLANT)

DATE	PARAMETER	MEASURED PARAMETER	OBJECTIVE LIMIT
12 June 1989	Colour	6.5 Hazen units	5 Hazen units
28 June 1989	Colour	5.5 Hazen units	5 Hazen units
9 May 1989	Colour	5.5 Hazen units	5 Hazen units
30 May 1989	Colour	9.5 Hazen units	5 Hazen units
19 Apr 1989	Colour	8.5 Hazen units	5 Hazen units
21 Apr 1989	Colour	5.5 Hazen units	5 Hazen units
8 Mar 1989	Colour	6 Hazen units	5 Hazen units
16 Mar 1989	Colour	16 Hazen units	5 Hazen units
21 Mar 1989	Colour	12 Hazen units	5 Hazen units
29 Mar 1989	Colour	9 Hazen units	5 Hazen units
1 Feb 1989	Colour	7 Hazen units	5 Hazen units
7 Feb 1989	Colour	6 Hazen units	5 Hazen units
9 Feb 1989	Colour	6 Hazen units	5 Hazen units
11 Jan 1989	Colour	10 Hazen units	5 Hazen units
16 Jan 1989	Colour	8 Hazen units	5 Hazen units
17 Jan 1989	Colour	5.5 Hazen units	5 Hazen units
18 Jan 1989	Colour	10 Hazen units	5 Hazen units
1 Dec 1988	Colour	7 Hazen units	5 Hazen units
29 Dec 1988	Colour	12 Hazen units	5 Hazen units
2 Nov 1988	Colour	9 Hazen units	5 Hazen units
7 Nov 1988	Colour	13 Hazen units	5 Hazen units
8 Nov 1988	Colour	9 Hazen units	5 Hazen units
10 Nov 1988	Colour	13 Hazen units	5 Hazen units
16 Nov 1988	Colour	13 Hazen units	5 Hazen units
24 Nov 1988	Colour	16 Hazen units	5 Hazen units
3 Oct 1988	Colour	7 Hazen units	5 Hazen units

SOURCE. Data from WTP Utility Monitoring Records

TABLE 7.0: ONTARIO DRINKING WATER OBJECTIVES
INCLUDING ALUMINUM (TREATED WATER AT PLANT)

DATE	PARAMETER	MEASURED PARAMETER	OBJECTIVE LIMIT
4 Oct 1988	Turbidity	1.05 FTU	1.0 FTU
18 Oct 1988	Colour	5.5 Hazen units	5 Hazen units
25 Oct 1988	Colour	7.5 Hazen units	5 Hazen units
27 Oct 1988	Colour	9 Hazen units	5 Hazen units
1 Sep 1988	Colour	8 Hazen units	5 Hazen units
7 Sep 1988	Colour	8 Hazen units	5 Hazen units
12 Sep 1988	Colour	9 Hazen units	5 Hazen units
8 Aug 1988	Colour	6 Hazen units	5 Hazen units
16 Aug 1988	Colour	5.5 Hazen units	5 Hazen units
30 Aug 1988	Colour	5.5 Hazen units	5 Hazen units
4 Jul 1988	Colour	7 Hazen units	5 Hazen units
6 Jul 1988	Colour	6 Hazen units	5 Hazen units
11 Jul 1988	Colour	5.5 Hazen units	5 Hazen units
12 Jul 1988	Colour	52 Hazen units	5 Hazen units
18 Jul 1988	Colour	6 Hazen units	5 Hazen units
19 Jul 1988	Colour	6 Hazen units	5 Hazen units
21 Jul 1988	Colour	6 Hazen units	5 Hazen units
22 Jul 1988	Colour	15 Hazen units	5 Hazen units
26 Jul 1988	Colour	17 Hazen units	5 Hazen units
8 Apr 1988	Turbidity	1.20 FTU	1.0 FTU
2 Mar 1988	Colour	11.5 Hazen units	5 Hazen units
2 Feb 1988	Colour	7.5 Hazen units	5 Hazen units
3 Feb 1988	Colour	6.1 Hazen units	5 Hazen units
8 Feb 1988	Total Coliforms	Present (1 Sample)	Absent
9 Feb 1988	Total Coliforms	Present (1 Sample)	ABSENT
19 Jan 1988	Colour	9.5 Hazen units	5 Hazen units

SOURCE: Data from WTP Utility Monitoring Records

TABLE 7.0: ONTARIO DRINKING WATER OBJECTIVES INCLUDING ALUMINUM (TREATED WATER AT PLANT)

DATE	PARAMETER	MEASURED PARAMETER	OBJECTIVE LIMIT
20 Jan 1988	Colour	6 Hazen units	5 Hazen units
26 Jan 1988	Colour	8 Hazen units	5 Hazen units
1 Dec 1987	Colour	5.5 Hazen units	5 Hazen units
8 Dec 1987	Colour	6 Hazen units	5 Hazen units
21 Dec 1987	Colour	6 Hazen units	5 Hazen units
3 Nov 1987	Colour	8 Hazen units	5 Hazen units
28 Nov 1987	Turbidity	5.7 FTU	1.0 FTU
5 Oct 1987	Colour	8 Hazen units	5 Hazen units
26 Oct 1987	Colour	5.5 Hazen units	5 Hazen units
1 Jun 1987	Colour	8 Hazen units	5 Hazen units
9 Jun 1987	Colour	8 Hazen units	5 Hazen units
15 Jun 1987	Colour	5.5 Hazen units	5 Hazen units
7 Apr 1987	Colour	6 Hazen units	5 Hazen units
3 Mar 1987	Turbidity	2.50 FTU	1.0 FTU
19 Jan 1987	Turbidity	1.30 FTU	1.0 FTU

SOURCE. Data from WTP Utility Monitoring Records

TABLE 7.1: ONTARIO DRINKING WATER OBJECTIVES
(DISTRIBUTION SYSTEM)

DATE	PARAMETER	MEASURED PARAMETER	OBJECTIVE LIMIT
12 Dec 1989	Total Coliforms	Present(1 Sample)	Absent
22 June 1989	Fecal Coliforms	Present(1 Sample)	Absent
2 Mar 1988	Total Coliforms	Present(3 Samples)	Absent
5 Aug 1987	Total Coliforms	Present(1 Sample)	Absent
25 Nov 1987	Total Coliforms	Present(3 Samples)	Absent

SOURCE: Data from WTP Utility Monitoring Records, Sheet B3

DRESDEN WATER TREATMENT PLANT

TABLE 8.0: FILTER BACKWASH WATER

MONTH	1989		1988		1987	
	TOTAL BACKWASH WATER (ML)	% OF TREATED WATER	TOTAL BACKWASH WATER (ML)	% OF TREATED WATER	TOTAL BACKWASH WATER (ML)	% OF TREATED WATER
JAN.						
FEB.						
MAR.						
APR.						
MAY						
JUN.						
JUL.						
AUG.						
SEP.						
OCT.						
NOV.						
DEC.						

No Data Available for WTP